The Electrical Review

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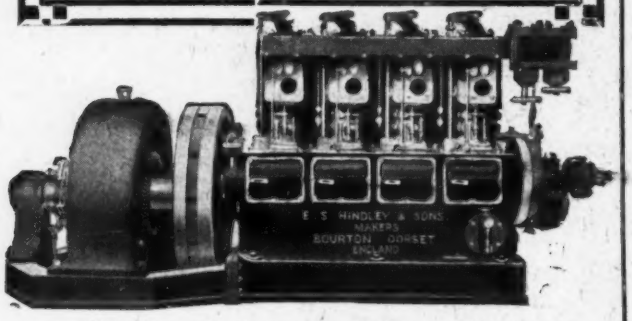

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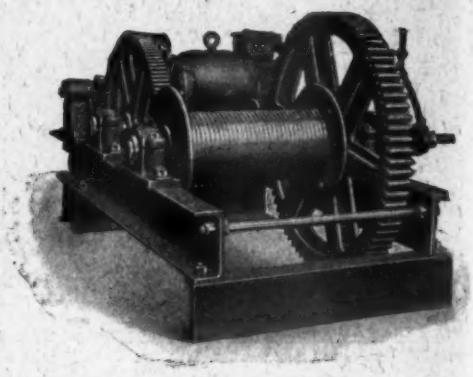

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THE

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VOL. XC. MAY 26, 1922. No. 2,322.

ELECTRICAL REVIEW.

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THE DISSECTION OF THE ATOM.

THE Kelvin Lecture which was delivered last week before the Institution of Electrical Engineers by Sir Ernest Rutherford was in the highest degree worthy of the occasion, and made the evening a memorable one in the minds of his crowded audience. With regard to the address itself, two features were conspicuously evident —that the author had no use for notes, and that he was labouring under the difficulty of condensing into a discourse of little more than an hour a mass of information sufficient for a whole series of lectures. No one alive knows more about this fascinating subject than Sir Ernest, who has himself made so many and so important contributions to atomic research, and who most fortunately is eminently endowed with that rare gift—the ability to impart his knowledge to others in simple terms. Had Lord Kelvin himself been present at the lecture devoted to his memory, we feel that he would have been foremost in appreciation of the splendid achievements described by the speaker, and of the manner in which they were discussed.

The subject is, as yet, so far removed from the interests of the workaday world that to many of the audience, no doubt, it was wholly unfamiliar ground. Even those who were more or less acquainted with the activities of the electron, a body believed to have a diameter of 0.00000000000037 cm., which is 100,000 times smaller than a molecule of hydrogen, might be excused for marvelling at Sir Ernest's courage in endeavouring to dissect the positive nucleus, which is far smaller; but the effort has already been justified by a measure of success giving promise of still greater achievements in the future. Bombarding nitrogen atoms with alpha particles emitted by radium—which are known to be nuclei of helium—resulted in the expulsion of hydrogen nuclei from the nitrogen atoms. Similar results were obtained from five other elements, indicating that hydrogen was a constituent of each of them; particular interest attaches to aluminium, in which case it has been shown that the hydrogen nucleus is endowed with greater energy than that contained in the projectile—the helium nucleus which drives it out. Thus we have here an example of energy artificially extracted from an atom—a hint of the profoundest significance, for if we could do this on the large scale, we should be able to propel a liner across the Atlantic with the energy stored up in a bucketful of clay. True, it has been suggested that, once started, the process might prove to be self-sustaining, and that the solid earth might be dissipated into primordial chaos. That is a contingency which may at last provide a solution to the troubles in Ireland and the Labour problem; but it is as yet remote. Sir Ernest Rutherford's projectiles only hit the target twice in a million rounds, and if all the alpha particles emitted by one gram of radium (136,000,000,000 per second) were fired into aluminium, he has said, the amount of hydrogen liberated by the disintegration of the aluminium nuclei could not exceed one-thousandth of a cubic millimetre *per annum*! There is a long and thorny path to tread before we unlock the boundless stores of energy contained in the ubiquitous atom.

We have laid some emphasis upon the immensity of the statistical data, on the one hand, and the infinitesimal magnitudes of the particles, on the other, that the modern physicist so confidently handles. Is that confidence misplaced? Those who have not followed and weighed the evidence as it has accumulated may be

pardoned for expressing incredulity, for certainly the statements seem incredible. But let them study the researches which have been so patiently conducted and so exhaustively recorded, and their doubts will be replaced by whole-hearted admiration of the men who have done the work; and they will rejoice to learn that this country's sons have led the way into this fairyland of science—Crookes, Lodge, Richardson, Thomson, Wilson, the Braggs, Soddy, Moseley, Rutherford, Aston—to name but a few of the workers.

Faraday, with a few coils of wire and bits of steel and sealing wax, laid the foundations of the electrical engineering industry. Who knows of what giant industry these researches into the constitution of the atom may be the germ? Of what momentous importance to the human race their fruits may become? We are surrounded by, and dependent upon, the products of scientific researches of the past, and every step forward is a matter for congratulation and a new endowment for our posterity.

Lock-out Developments.

To say that public disappointment is felt over the breakdown of the negotiations which were started so hopefully last week is to speak mildly. Following on the report of the Industrial Court, upon which we commented in our issue of May 19th, the employers offered terms based upon Sir William Mackenzie's findings. The offer was at first turned down, and the A.E.U. declined even to continue negotiations. Communications were made to the Press by members of the A.E.U. Executive to the effect that there would be no object in their attending the conference if the same proposals as had been rejected were to be discussed. This we could not understand, and we felt that it would have been an "object" to suggest alternative terms. Early this week, however, the A.E.U. prepared counter-proposals which were to be submitted to the employers on Wednesday, but the A.E.U. declined to be influenced by any action that the 47 other unions might take in the direction of peace. These 47 unions are to be ballotted regarding the employers' latest proposals, and the result will be known on June 2nd. The A.E.U. will gain little and may lose much by its policy of isolation. The public justifiably wants to learn why, after invoking the Industrial Court, the conclusions of which seem fair not only to the public, but to the other unions, the A.E.U. alone should reject them.

Matters will *have* to be settled in conference sooner or later. Whether the conflict be ended now, or whether the A.E.U. pawn its premises while its members and their wives and families are reduced to the lowest ebb of poverty and distress, the negotiators must finally agree terms round a table. That side comes out victorious in a trade dispute which has the backing of enlightened public opinion. Before the Industrial Court let in the daylight, the employers, thanks to a lack of publicity as to their aims and an almost ostentatious disregard for the views of the public, had decidedly the lesser share of that backing. The sympathy of the public will unfailingly be lost by a policy of stubborn obstinacy, by whichever side displayed, and any attempt to hold up public utility undertakings in London will arouse the wrath of practically the whole community. No more suicidal weapon could be used.

Writing in the absence of the counter-proposals, we assume that, reduced to the lowest terms, the dispute is between the following two methods of putting the case as to the managerial functions:

> "The employers have the right to manage their establishments and the trade unions have the right to exercise the proper functions of trade unions." (Employers.)
>
> "The right of the employers to exercise managerial functions in their establishments shall continue as hitherto, and the Union shall have the right to continue to perform its proper functions." (A.E.U.)

It will be noted that the employers have changed the wording, so that "shall not interfere" does not occur. We may note also that the word "continue" occurs twice in the alternative wording contained in the A.E.U. statement, and we know that that means that the relations established during the stress of war conditions, and since, are to continue. But surely the A.E.U. must see that wartime conditions were very different from the ordinary conditions of business, let alone the depressed conditions which exist now. Then, manufacturing establishments were choked and congested with business. There was practically no unemployment. Now, orders are scarce, competition is keen, shops are empty, and business cannot be obtained unless it is certain that the manufacturer will be able to keep his delivery promise. The manufacturer *must* be the one to decide what overtime is necessary, and by what processes his product shall be made, and he must be able to act promptly. Moreover, it was proved before the Industrial Court that the custom of the trade had been for the employer to decide these questions.

While we can hardly admit that the clauses quoted are, as has been said in one newspaper, of a platitudinous nature, we believe it would be best to endeavour to come to an agreement in general terms, and to trust to the ingenuity and good sense which Sir William Mackenzie found to have prevailed in the past. Such agreement cannot, however, be arrived at if the A.E.U. continues to adopt an obstinate attitude devoid of goodwill and reasonableness. We repeat that the moral support which it has hitherto enjoyed will be withheld if the Union acts in a spirit so lacking in sportsmanship as to refuse to accept the verdict of the tribunal it was most instrumental in setting up.

The Solemn Duty of Remembrance.

Though we are a specialised technical and trade journal and only occasionally make appeal to the general non-electrical public, we receive numerous requests from charitable and other organisations for publicity to be given in our pages to their very deserving objects. It is never easy to refuse applications of such a character, but it often has to be done. Sometimes it is impossible to adopt that course, for an overwhelming sense of duty urges us, and sometimes feelings of deep gratitude to those whose debt we can never expect fully to repay, compel us. Such a case is that of Field-Marshal Earl Haig's Remembrance League—an "appeal for ex-Service men of all ranks." Membership of the Remembrance League is intended to denote that we remember that this country was saved by the ex-Service men of all ranks for whom Earl Haig is now appealing. There are many of these men and their dependents, the widows and orphans of those who fell, and the disabled as well, who are in sore need and distress, especially just now, and they can be and are helped through the medium of the Benevolent Branch of the British Legion, but the need for funds is great. Earl Haig appeals—and who has a better right to make demands upon us in such a connection?—for men and women to enrol themselves as members of the Remembrance League, and in doing so to undertake to subscribe annually an amount according to their means. No words of ours could strengthen that appeal. Captain W. G. Willcox, the Organising Secretary of Earl Haig's Appeal for the British Legion, confidently awaits a response from our readers, at his office at British Columbia House, 1, Regent Street, London, S.W.1. The State makes heavy demands upon our earnings, and trade is not in a flourishing condition, but we must not let these objections deafen our ears to the appeal of our generosity or stifle in our consciences the sense of our responsibility.

Fair Contract Conditions.

We are glad to note that the Federation of British Industries has moved in the matter of obtaining in public contract specifications fair and uniform contract conditions. It has appointed a large and representative committee to consider the whole subject. This committee has prepared a number of specimen general conditions which it is submitting to the members and associate members of the Federation for their

consideration and approval, and it is taking the necessary preliminary steps to secure their adoption. These fundamental conditions, which are intended to apply to all contracts entered into by public bodies, refer to the following questions:—(*a*) Arbitration. (*b*) Delay in delivery. (*c*) Damages for delay. (*d*) Liability for accidents and damage. (*e*) General liability of contractor; and (*f*) Fair wages clause. The Federation asks its members to furnish—in confidence—concrete instances of cases where hardship and injustice to the contractor have resulted from present-day conditions, and their alternative suggestions to the Committee's proposals.

As the most practical method of working, the Committee approached the War Office, seeking through it an interview with a Government Contracts Co-ordinating Committee, which consists of representatives from the Admiralty, War Office, Air Ministry, and other Government purchasing departments. It feels that if it could induce the Government to adopt these general conditions, the moral effect upon individual municipalities, and eventually upon public companies and their consulting engineers, would be such that their general adoption would be considerably hastened. Many of our readers will remember the long-standing and continuous interest of the ELECTRICAL REVIEW in this subject. Some twenty-five years ago we drew attention in a long series of articles to the very unfair general conditions which at that time commonly formed part of electrical plant specifications. Public opinion then, and continuously since, has caused the most flagrantly unjust stipulations to be modified, and in recent years the production by the Institution of Electrical Engineers of a model set of General Conditions for electrical contracts has done much to standardise the conditions attaching to electrical plant contracts.

Much remains to be done to codify and simplify the general conditions embodied in general public contracts, and we wish the Federation every success.

The War Office has replied to its request on the lines of suggesting separate negotiation with each Department rather than the settlement of principles with a representative Government Committee and the subsequent application of details with each Department. The Committee, however, feels that its contention of settling principles first is the right one, and it is continuing its efforts to secure the interview with the Co-ordinating Committee that it considers essential.

The Significance of Corrosion.

SIR ROBERT HADFIELD'S paper on "The Corrosion of Ferrous Metals," read last month before the Institution of Civil Engineers, will for many years be regarded as a classic by engineers, metallurgists, and chemists. Sir Robert is correct in emphasising the importance of producing alloy steels which have the capacity of resisting corrosion. Of very great value to the general community is an understanding of the financial cost of the corrosion that is taking place. We doubt whether an estimate from any one else than this talented Past President of the Iron and Steel Institute would carry anything like the authority of the startling figures put forward. Sir Robert estimates that in 1920 the loss by rusting in use was 29,000,000 tons of steel. For that year, taking steel at £20 per ton, and after making allowances for protection, &c., the annual cost of wastage is estimated as probably over £700,000,000 sterling. Sir Robert gives this figure for the whole world: as our personal guess (and it is only a guess), and having in mind alike the tonnage of its mercantile marine, its railway mileage, its diverse minor uses, and in our big cities the adverse atmospheric conditions, it is not too much to assume that two-thirds of that loss, say £450,000,000, represents a wasting of the wealth of the United Kingdom and the allied Dominions, Commonwealths and Colonial possessions which go to make up the British Empire. If, then, this loss of £450,000,000 (nearly half our Budget) could be reduced by one-third, the effect in six or seven years would be the accumulation of a sum equal to our present war indebtedness to the United States.

It is no mean task that is open for our attainment, and the race which has given the world rustless table cutlery, to say nothing of the slowly corroding silicon steel, may yet provide joists, channels, and angles for our structures and plates for our boilers and ships having all the required mechanical properties, and a greatly lowered coefficient of relative corrosion. But even given the new steels, we are confronted by the fact that such can only come into use on new work and in the replacements of old work. Therefore, even when the metallurgist has solved the problem, it will be many decades before the usage of relatively corrosionless steels can become universal.

Even then we are not able to forecast whether or not these new steels will still require protection with paint. Probably they will. Meanwhile, is there not something to be said for a scientific study of paints? A good paint properly applied to a clean iron or steel surface, and properly maintained, will retard corrosion to a very appreciable extent.

We appear to lack scientific standards for the predetermination of the insulating* value of paints. At present we are content to judge their value after the lapse of two or three years. Such judgments of value are often vitiated, and an unfair and adverse opinion deduced with regard to a good paint, because it may have been applied in a slovenly fashion to a rusty surface. The whole engineering world does need authoritative standards in order that tests may be made to predetermine in a few days, or at most weeks, the suitability of any paint to meet any specified conditions.

As compared with other branches of engineering, those concerned with the control of large electrical undertakings are sparing users of paint. We do not mean parsimonious, but the quantities of paint required to maintain their structures in good condition are small. Yet with the extension of electric traction, the increase of overhead transmission lines of all sorts, and the maintenance of the roofing and other steelwork of our power stations, the electrical engineer will be more and more concerned with the protective efficiency of paints.

Apart from paints, there are other aspects of corrosion which interest us keenly. The increased use of electric welding has, for example, raised the question whether liability to corrosion is not enhanced by the proximity of welded to unwelded areas. Again, too, we have all been relieved by the successful efforts of the metallurgist to retard the corrosion of turbine blades and condenser tubes. Some suspect that yet other corrosion troubles are germinating and will make themselves apparent shortly. There is therefore every personal reason why the electrical engineer should follow closely all searchings after means to alleviate or to prevent corrosion, in addition to the wider economic reason of reducing that enormous bill of £700,000,000.

Small Generating Stations.

AN important announcement made by the Electricity Commissioners is recorded in our columns to-day. The Commissioners have decided to take no notice of private generating stations up to 50 kW, which can now be put down without even communicating with them, and may be of any type, d.c. or a.c. Whilst, no doubt, the Commissioners readily consented to the establishment of such installations when applied to, the mere necessity of making such an application has a deterring effect on the mind of a man who is contemplating the step. Hence the removal of the formality is conducive to the quicker development of small village lighting undertakings, for which there is an enormous scope.

*The word insulating is not used in its electrical sense, although all paints have a certain small value as an electrical insulator by virtue of their high resistance.

D

THE THEORY OF ACTION OF THE "SHORT WAVE" CONDENSER.

By F. ADDEY, B.Sc., M.I.E.E., Fellow I.R.E.

The arrangement used for obtaining a short wave in the ship sets of the Marconi Co., by placing a condenser in parallel with the secondary of the transmitting jigger, although so widely used in practice, does not appear to be anywhere satisfactorily described in print.

The writer is acquainted with only one text-book in which a description and explanation of this device are given, and in this case the explanation is far from complete. It is therefore thought that the method of explaining the action of the short-wave condenser given below will be of interest.

As an introduction, it is necessary to consider the following arrangement:—

If we have a condenser and an inductance joined in parallel, and we apply an alternating voltage v of frequency n to the terminals of the condenser, as shown in fig. 1, then if the magnitudes of the condenser and inductance are so adjusted that the oscillatory circuit which they form is tuned to the frequency n, that is, if $pL=1/pC$, where $p=2\pi n$, and if there is no resistance in either of the parallel paths, no current will flow through the inductance-condenser combination.

This can be shown as follows:—

The current vector through L will be of magnitude v/pL, and will lag 90° on v. The current vector through C will be of magnitude vpC and will lead 90° on v. If $pL=1/pC$ these two current vectors will be of equal magnitude, and as they differ 180° in phase they will exactly cancel one another, and therefore the resultant current flowing from the alternating voltage supply will be zero.

Since, however, as regards the circuit round L and C, these two current vectors are in phase with one another, an alternating current of magnitude v/pL *or* vpC will flow round this circuit.

The resistances which cannot be avoided in the paths of I_L and I_C will cause the respective current vectors to differ in phase from the applied voltage vector by less than 90°. They will therefore not exactly neutralise one another, and there will consequently be a resultant current from the source of supply. This current, which will usually be small, makes good the energy losses due to the resistances.

Suppose, now, we replace the condenser C by two condensers C_1 and C_2 in series, and we make the connection with the external supply to the terminals of the condenser C_1, as shown in fig. 2. It will be shown that, if the circuit L C_1 C_2 be tuned to the frequency n, the combination of the parallel paths C_2L_2 and C_1 will act as a barrier to currents from the external supply at this frequency.

We shall have:

$$I_L = v/(pL-1/pC_2)$$
$$I_C = v/(1/pC_1).$$

Since, by hypothesis, $pL=1/pC=1/p\times(1/C_1+1/C_2)$, therefore pL is greater than $1/pC_2$. That is, in the path through C_2 and L, the inductance reactance will be greater than the capacity reactance, and therefore the current vector I_L will lag 90° on v.

In the path through C_1 the current vector I_C will, of course, lead 90° on v.

Hence, if we make $I_L = I_C$ we shall in this case also get the two current vectors cancelling one another, and therefore no current will flow from the supply.

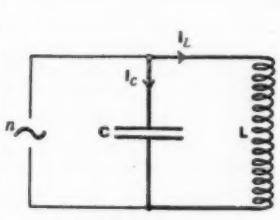

Fig. 1.

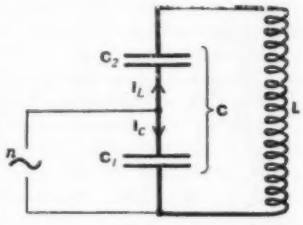

Fig. 2.

To make $I_L = I_C$ we must have $pL-1/pC_2=1/pC_1$, or $pL=1/p\times(1/C_1+1/C_2)$. But this is the case, by hypothesis.

Hence the arrangement shown in fig. 2, when tuned to the frequency n, acts as a barrier to currents of this frequency, similarly to the arrangement shown in fig. 1, while at the same time a current of frequency n flows in the circuit LC_1 C_2. Any resistances in the paths will have the effect, as already explained in connection with fig. 1, of reducing the phase difference between the current vectors, and so causing a "make-up" current to flow from the source of supply.

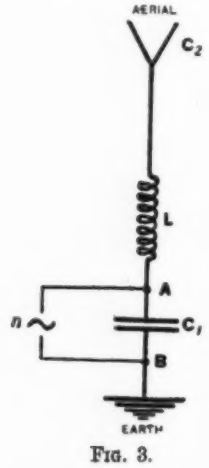

Fig. 3.

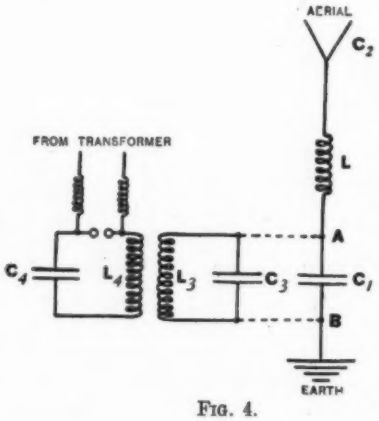

Fig. 4.

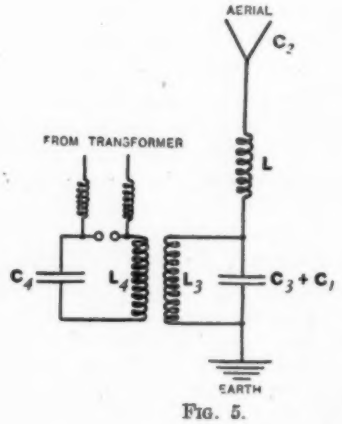

Fig. 5.

The aerial circuit shown in fig. 3 is electrically equivalent to that shown in fig. 2, the capacity of the aerial to earth taking the place of the condenser C_1 in fig. 2. Therefore, if we tune this aerial circuit to the frequency n, and make connection at the points A and B to a supply at this frequency, only the small "make-up" current will flow from the supply, while at the same time the aerial will be set into oscillation.

The alternating supply to the aerial circuit can be taken from the terminals of a condenser C_3, which is joined in series with an inductance L_3 to form an oscillatory circuit adjusted to the frequency n (fig. 4). The circuit L_3 . C_3 is excited from another oscillatory

circuit $L_4 . C_4$, in which a spark gap is placed, and which is set into oscillation in the usual manner.

We therefore now have the circuit consisting of the aerial with L and C_1 in series set into oscillation, and since only the small make-up current will be flowing from the circuit $L_3 . C_3$ to the aerial circuit, these two circuits can be considered as oscillating independently of one another. Since, however, the terminals of the condenser C_1 are joined to those of C_3, these two condensers can be replaced by a single condenser of capacity equal to the sum of the capacities of the separate condensers.

We therefore finally obtain the arrangement shown in fig. 5, which is the arrangement actually used.

It may be of interest to give some figures for an actual installation. These figures refer to a large land station at which the short-wave condenser arrangement is used to produce a 600-metre wave for communication with ships.

The aerial has an inductance of 52 microhenrys and a capacity of 5.4 jars (.006 microfarad).

L_3 is 28.9 microhenrys, and (C_3+C_1) is 5.76 jars (.0064 microfarad). When oscillations of a frequency of 500,000, corresponding to a wave length of 600 metres, are impressed on the circuit, the condenser (C_3+C_1) automatically divides itself into two parts, of 3.16 jars (C_3) and 2.6 jars (C_1) respectively.

A capacity of 3.16 jars in series with L_3 of 28.9 microhenrys, and a capacity of 2.6 jars in series with the aerial having the electrical constants mentioned, each give an oscillatory circuit tuned to 600 metres.

Thus the actions explained above take place, and a 600-metre wave is radiated.

THE ROYAL SOCIETY'S SOIRÉE.

During the evening of May 17th a representative gathering of Fellows and guests was welcomed at Burlington House, Piccadilly, by Sir Charles Sherrington, K.B.E., M.D., president, the occasion being the annual conversazione that is held by the Society. The main interest, as usual, centred on the exhibits, and demonstrations attracted attention throughout the evening, in the course of which Lord Rayleigh, F.R.S., lectured on "The Aurora Borealis and its Spectrum," and with the aid of photographs illustrated some recent spectroscopic investigations on the aurora, particularly its occurrence on ordinary nights in the South of England.

One of Messrs. Ogilvy & Co.'s exhibits was a new electric microscope lamp for research work; this embodies several useful features. The hood is so constructed that it gives the maximum ventilation combined with the minimum of reflection, which materially lessens the fatigue experienced in long periods of microscopical observation. The hood is in the form of a vertical steel cylinder, on the flat top of which is fitted a push-bar switch and a standard bayonet lamp socket. On the front and inside of the hood is permanently fitted an iris diaphragm close to the side of the lamp bulb, which serves the double purpose of regulating the size of the source of light and enables the user to project an accurately focussed image of the light source. The hood is fitted to a detachable circular brass base, and a clamping screw ensures the hood's being replaced to the correct position of alignment. In front of the base is attached a small prismatic optical bench supporting a condensing system, iris diaphragm, and light filter holder. The condensing system holder is fitted with screws so that the condenser may be accurately centred to the permanently fixed iris diaphragm and may also be interchangeable. This holder is on a hinged mount so that the condenser may be conveniently swung out of the optic axis when not required and a strong spring catch ensures accurate alignment when it is replaced. The lamp may be raised or lowered to any desired position, and the hood with its components may be inclined to any angle required. The electric lamp bulb is of the gasfilled type but made of a special mixture of glass which presents an exceedingly fine opal surface. The metallic filament is entirely obscured; the opal glass diffuses the rays emanating from the filament and when the surface of the glass bulb is sharply focused in the plane of the object, *i.e.*, the aperture of the iris diaphragm which is practically in the same plane as the surface of the electric lamp, there is no structure or granular matter shown in the field of view, and consequently no interference with the image of the object.

The National Institute for Medical Research had on view a new type of microscope outfit designed to give great stability and, therefore, specially suited for work with high powers. The illuminating medium is a mercury-vapour lamp of new design and high efficiency, and methods were shown of modifying the light intensity so that under any conditions of use the light that reaches the eye is constant in quality and quantity. In photographing micro-organisms by means of ultra-violet light, it has recently been found possible to utilise shorter wave-lengths than any hitherto used. Photomicrographs were shown to demonstrate the result of photographing stained bacteria by visible light and unstained living bacteria by ultra-violet light.

The Western Electric Co., Ltd., showed telephone transmission apparatus that gives direct readings of the transmission loss, in miles of standard cable, of telephone circuits and apparatus. The instrument is so constructed as to give visual readings, eliminating the need of aural observations. Associated with and supplying current to the set is a high-frequency oscillator in two parts: (1) Voice frequency oscillator—a thermionic tube generator arranged to give frequencies from 200 to 3,000 cycles per second, and (2) ultra-audio frequency oscillator—a thermionic tube generator, which extends the range of the voice frequency oscillator up to 50,000 cycles per second, normally in steps of 100 cycles. The oscillators give a uniform output at all frequencies and have a pure wave form.

The Science Museum, South Kensington, loaned the original microphones and historical experimental apparatus made and used by Prof. David E. Hughes, F.R.S., in his experiments, which led him from the discovery of the microphone in 1878 to the transmission and reception of wireless signals in 1879. The original model of his induction balance was shown, as well as several examples of pencil and granular microphones; also his transmitting and receiving apparatus for wireless signals. [Prof. Hughes exhibited his induction balance at the Royal Society's conversazione on May 28th, 1879.]

Mr. A. A. Campbell Swinton, F.R.S., exhibited specimens of the results obtained by several different methods of recording wireless signals, as follows:—(1) Photographic records from a string galvanometer directly connected in the aerial circuit; (2) photographic records from a sensitive manometric flame caused to dance to telephonic sounds; (3) records by siphon pen and Morse inker, actuated by Brown relays and crystal detector; (4) records by siphon pen actuated by thermionic valves; (5) Creed perforated tape obtained with thermionic valves, and resulting print in Roman type. The string galvanometer records were obtained in 1910 in Copenhagen, with signals sent from Tralee, in Ireland. All the others were taken in London, some of them before the war, from sundry transmitting stations, many of which were in different parts of Europe, the most distant being that at Moscow.

The Royal Observatory, Greenwich, had on view, amongst other things, Admiralty magnetic charts, 1922,

showing curves of equal magnetic variation and dip and of equal horizontal force.

A most fascinating demonstration was that of the Cutting Tools Research Committee of the Institution of Mechanical Engineers (Sir John Dewrance and Prof. E. G. Coker, F.R.S.) of the action of milling and planing tools. A milling cutter, driven by a small motor through reducing gear, was arranged to take definite depths of cut from strips of transparent materials, while the latter were moved continuously up to the cutter by an ordinary feed motion. The cutting action of the moving teeth was viewed in polarised light, and shown to be somewhat complicated, as compared with that of a single planing tool; the latter can be shown in action with the same apparatus.

An ingenious device was the micro indicator of the Cambridge and Paul Instrument Co., Ltd., for taking diagrams from high-speed engines. It was designed by Mr. W. G. Collins, and was shown mounted on a cylinder. The vertical movement of the end of the indicator piston deflects a strong triangular spring carrying a stylus. By an electro-magnetic device, preferably operated by an automatic switch, this stylus is made to scratch a micro diagram of a single complete cycle upon a disk of transparent celluloid. After taking a diagram the disk can be rotated by a ratchet connected to a Bowden wire, so that ten separate diagrams may be taken in rapid succession. The movement of the piston is very slight and the moving parts are light, and hence the inertia of the moving system is small and the natural period short, also the capacity of the cylinder is small. The actual size of the indelible record obtained is approximately 3 mm. base (time) by 2½ mm. height (pressure). The records can be photographically enlarged, or projected for observation or tracing or read with a microscope. The indicator is particularly suitable for indicating the engines of aeroplanes whilst in flight or of motor cars in motion.

To physiologists working on respiration and the respiratory functions of the blood, it is important to be able to measure the carbon-dioxide in alveolar air. The instrument shown, suggested by Prof. A. V. Hill, provides a convenient and accurate way of measuring this percentage. The patient breathes out in the ordinary way and then, by an effort, expels through a katharometer of the Shakespear type, the residue of the gas in the lungs which has been in actual contact with the blood system. The percentage of CO_2 in this residue is then read on the indicator scale, which is calibrated 0–10 per cent. CO_2. The whole outfit is contained in a portable case.

Mr. W. M. Mordey demonstrated some effects of alternating magnetism, his experiments illustrating, among other effects, the following:—(1) Repulsion from a multiphase electro magnet of magnetic materials, including finely divided iron, nickel, cobalt, magnetite and specular hæmatite. (2) Steady movement or migration of these materials through or from a multiphase field in a direction opposite to that due to eddy currents. Slow rotation of materials on their own axes under certain conditions. (3) In 1-phase field, iron, nickel, cobalt and magnetite act as in a uni-directional field. (4) Repulsion from the poles of a 1-phase magnet, of finely divided specular hæmatite (a feebly paramagnetic substance) which forms a ring round and at a distance from each pole—a development of the "equatorial" formation. (5) The formation in a multiphase field of "planes of force" by iron, nickel, cobalt, and magnetite. (6) No movement of finely divided aluminium in a multiphase field nor of lead shot. (7) Water containing any of the above materials driven uphill in a multiphase field—a surface-tension effect. (8) The possibility of application to the concentration or separation of certain minerals, wet or dry. It is said that the above effects appear to be associated with hysteresis—or rather with hysteresis/susceptibility—the movements of repulsion and migration increasing with the frequency up to at least 85 periods per second. At 150 and at 350 periods magnetite and specular hæmatite exhibit only paramagnetic properties, standing erect without motion and oriented to the poles. It is assumed that with these materials, hysteresis has ceased or greatly diminished at 150 periods.

(To be continued.)

HYDRO-ELECTRIC COURSE AT GRENOBLE UNIVERSITY.

SUMMER HOLIDAY COURSE, 1922.

It will be remembered that a course of instruction on the subjects of hydro-electric installations and power transmission was inaugurated two years ago for British students at the Polytechnic Institute, University of Grenoble, in the French Alps. We have referred to the matter from time to time, and as there is no such centre as Grenoble in the British Isles where the practical study of water-power developments can be undertaken, it is hoped that the French effort will continue to meet with success, especially as it is considered of some importance that the *Entente* which was formed between many British and French engineers during the war period should be maintained.

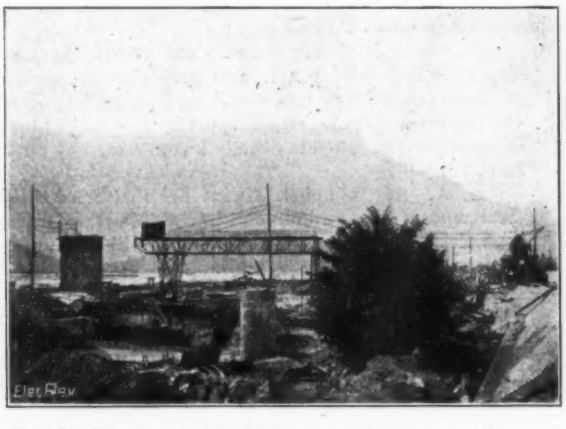

Fig. 1.—Dam under Construction at Grenoble, and Power Lines.

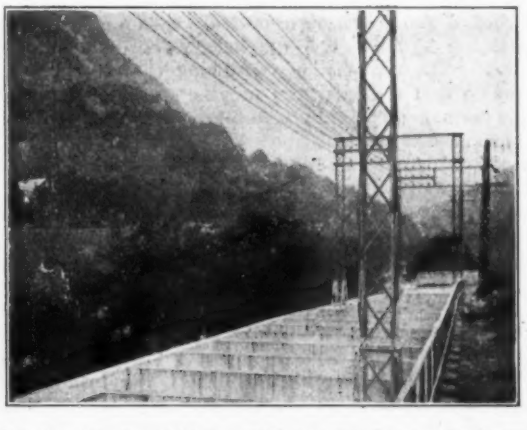

Fig. 2.—Armoured Concrete Flame and Power Conductors.

The course is held during the August vacation in order that British students may attend; this year the course will commence on August 7th, and will extend

over approximately four weeks. The lectures will be given in easy French of a character that anyone who has learned French at school should be able to understand without difficulty. A special course of French for those who do not know the language sufficiently well to take the course will be given during the four weeks preceding the beginning of the technical course at a special fee.

A special feature of the course is the visits paid to some of the numerous water-power installations at work

Fig. 3.—A 3-phase Village Transformer Post.

Fig. 4.—Old and Modern h.p. Transmission Lines.

or under construction in the neighbourhood, in order to illustrate points emphasised in the lectures. Installations of a number of different types can be seen in the neighbourhood.

The fees for the lecture course will be 110 fr., or about £2 10s. at the present rate of exchange. A special committee exists at Grenoble to assist students to find suitable accommodation, the cost of which varies from 240 to 600 fr. a month, or about £5 to £12. Half-rate tickets will be granted on the French railways from a French port to Grenoble and back for students under the age of 28 years, but to obtain this advantage arrangements must be made well in advance through the Office National.

The lectures are of a thoroughly practical character. The course should prove valuable not merely to engineering students, but also to mechanical and electrical engineers who wish to keep in touch with recent developments in hydraulic power and in allied electrical transmission. It is possible for engineers beyond the student stage to spend an enjoyable holiday at Grenoble and learn something at the same time.

Grenoble is a delightful centre for excursions in the French Alps, and it is by no means expensive. In the past the directors of some of the local works using electricity for motive power, for electrometallurgical work, and for electro-chemistry have been very kind in showing matters of interest to students attending the course. Some of the earliest power transmission work in France was carried out in the Grenoble district, so that the advances that have been made can be studied and the effect of time noted.

With regard to the accompanying illustrations, the first is a reproduction of a dam under construction at Grenoble, with the three-phase transmission lines for supplying driving power for the contractors' motors. Fig. 4 is a view of power lines near Grenoble, comprising a multiple 26,000-volt line erected over 20 years ago, and a modern 40,000-volt one running alongside the main road. Fig. 3 shows a three-phase village transformer post which has evidently been erected with some regard to economy, but good enough for the job; while fig. 2 shows an armoured concrete flume in the Drac Valley, above which the conductors carrying power to electro-chemical works can be seen.

Further particulars can be obtained from the Office National des Universités et Ecoles Françaises, 45, Great Marlborough Street, London, W.1.

THE SIEMENS ELECTRIC LAMP WORKS.

Last week we paid a visit to the electric lamp works, Dalston, of Messrs. Siemens Bros. & Co., Ltd., and inspected the various processes which are there carried on, from the raw oxide of tungsten to the finished gas-filled lamp. The factory, which was erected 20 years ago, has always been employed in manufacturing metal-filament lamps, Messrs. Siemens having led the way by placing on the market the first commercially satisfactory lamp of this type—the tantalum lamp, which was manufactured in large quantities up to the outbreak of the war. The manufacture of drawn-wire tungsten-filament lamps had been commenced in 1908, but did not entail the abandonment of tantalum, the superior strength of which made up for its lower efficiency in many industrial applications; however, the difficulty of obtaining supplies of raw material during the war and the improvement in the quality of tungsten lamps led to the suspension of the tantalum lamp manufacture. On the other hand, whereas only straight filaments had been used at Dalston up to 1913, the manufacture of spiralised filaments and gasfilled lamps has been greatly developed since that date. In 1910 the range of tungsten drawn-wire lamps was extended to cover all the usual patterns, which were sold under the trade name, "Wotan"; and in 1911 the Siemens Wotan traction lamp, having a spiralised filament suspended on a special spider, was introduced, with highly satisfactory results, the lamp being widely adopted for lighting tramcars and railway trains. Lastly, the manufacture of gas-filled lamps was begun in 1913, and large numbers were made, under difficulties, during the war; development has continued in this direction, and the works are now well equipped for producing gasfilled lamps in large quantities. Special gasfilled lamps are made for projection and optical purposes, with concentrated filaments, in various arrangements, and gasfilled lamps

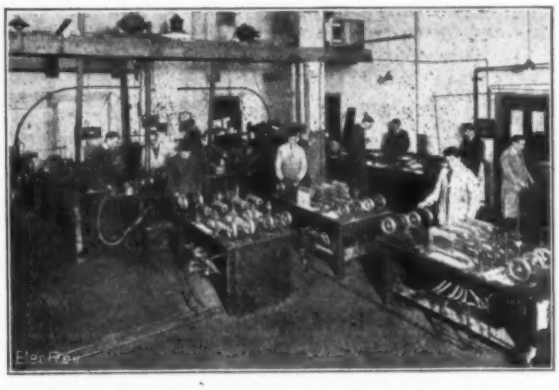

Fig. 1.—Swaging and Wire-Drawing Machines.

designed for automobile and locomotive headlights have been introduced, all these tungsten lamps being now sold under the trade name "Siemens Britannia."

Great strides have been made in the manufacture of tungsten wire since the early days when filaments were not drawn wire but fragile aggregations; yet the pro-

cesses by which the drawn wire, of extraordinarily high tensile strength, is made, are in the main unchanged, being similar in many respects to those by which tantalum wire was made. The invention of the gasfilled lamp, with its concentrated spiralised filament heated to a very high temperature, presented new problems to the metallurgist, demanding still higher qualities of wire. At the Siemens works close attention has been given to this subject, and as the result of the researches there carried on a brand of tungsten wire has been produced from which exceptionally good results have been obtained. The chemical department is well staffed and equipped, as is due to its great importance in this industry, and an elaborate system of photomicrographic examination of the tungsten at every stage of its manufacture has been developed.

We have previously described the mode of preparation of tungsten on several occasions, but a *résumé* of the process may be of interest. It commences with the commercial tungstic oxide, which is first thoroughly purified by prolonged chemical treatment, and then reduced to a metallic powder by heating in a current of hydrogen. This powder is pressed into a stick 7 in. long by ¼ in. square, which is baked in order to increase its strength. The baked slug is then sintered by raising it to a blinding white heat by means of an electric current in an atmosphere of hydrogen, becoming

Fig. 2.—Fine-wire Drawing Machines.

a solid bar of tungsten. The sintered slug is next passed through swaging machines, by which its diameter is reduced from ¼ in. square to 32 mils round wire, whilst its length is increased from 7 in. up to over 30 ft. The wire is drawn through a succession of diamond dies until it is reduced to the diameter desired.

Photomicrographs of the tungsten are taken, both in slug and wire form, for the purpose of examining the grain and fibrous texture of tungsten produced from various mixtures, as well as the changes which take place after the same tungsten has been under current in an electric lamp.

The spiralising of the filament is done exclusively by machinery. For the heavier gauge wires, Messrs. Siemens Brothers are using a number of automatic machines of their own design, which can be regulated to wind any desired style of filament.

The wire is wound on a mandrel in a somewhat similar manner to that employed for making an ordinary spiral spring, with the exception that in these machines the holder contains a drum of tungsten wire and is carried on a traversing attachment to ensure even winding. The wire is passed through adjustable tension grips, and the traverse is automatically "tripped" at certain intervals so that a number of short straight lengths of wire are left between the sections of spiralled filament. These facilitate mounting on the spider, and occur where the filament passes through the supporting loops.

For fine wires a different system is adopted. A mandrel composed of soft brass wire is fed into the machine from a drum, and the filament is spiralised round this as it passes through the machine. Then the wire mandrel with the spiralised filament round it is rewound on a separate drum. Owing to the small diameters worked on these machines, it is practically impossible to remove

Fig. 3.—Sealing-in Department for Standard and Gasfilled Lamps.

the spirals from the mandrel in the ordinary manner without damaging them, and in this case the mandrel is dissolved in a chemical solution, leaving the spiralised wire intact, ready for mounting on the spider.

The interior glass structure which provides a sealed entry for the conducting wires, and to which the filament supports are attached, is known as the combined foot and spider. The glass tube of which the foot is composed is first cut up into the required lengths, which are flanged at one end to form a base to seal into the bulbs, by automatic machines which are provided with a magazine feed, and work without attention.

The leading-in wires, stem, and foot are next assembled on the foot-making machines; the glass components are heated to a suitable temperature by means of gas flames and the "pinch" is made, which hermetically seals the lower end of the flanged tube and at the

Fig. 4.—A Section of the Exhausting and Gasfilling Department.

same time welds the stem and the leading-in wires into the "seal."

In building up the spider a suitable number of buttons are first formed on the stem; the radial supports are then fixed into these. In the past these two operations were carried out separately and by hand, but Messrs. Siemens Brothers have installed some special machines in which the two processes are combined. The wire used

for the spider arms is fed from a bobbin into the machine, which automatically adjusts the lengths of the supports and forms the pigtail loops—an extremely clever example of automatic operation.

In the case of high-wattage gasfilled lamps, where the leading-in wires end in metal tape electrodes, the ends of the filaments—which are necessarily of fairly heavy gauge—are secured to the tapes by a process of spot welding. All spirals are carefully inspected before being mounted on the "foot." The very fine filaments used for the 30- and 40-watt gasfilled lamps, of wire approximately 1/1,000th of an inch in diameter, are examined by placing them in an optical apparatus, which projects the image of the spiral—highly magnified—on to a screen.

The process of enclosing the "foot" and filament within the bulb is called "sealing in," and for this purpose also machines are used.

The modern trend in electric lamp making is in the direction of so-called "pipless" lamps, in which the pip is concealed within the cap of the lamp, thus leaving the base of the bulb perfectly rounded. This is arranged for when the "foot" is made. A small stem tube is passed through the flanged leading-in tube, and welded on to the "foot" just above the "pinch." The filament is then mounted, and the completed foot is sealed into the neck of the bulb in the ordinary way. The bulb is afterwards exhausted through the stem tube, and the pip is formed at the cap end of the bulb.

Fig. 5.—Capping and Testing Department.

It is found that this method does not add materially to the cost of manufacture, while the elimination of the "pip" end from the finished lamps considerably reduces breakages in transit.

The lamps are exhausted entirely by Siemens patent rotary oil pumps, after which the filling gas is admitted to the bulb by means of a two-way valve, under a predetermined pressure. After gasfilling the bulb is sealed. A new type of pump has been devised which is completely automatic in its action. This apparatus not only exhausts the bulb, but also tests for vacuum, gasfills, and seals the bulb.

The factory is well equipped with various types of photometers, including a sphere photometer by which the spherical candle-power of gasfilled lamps can be measured directly.

On another photometer special adjustments have been fitted which allow comparisons to be made of the temperature of the filament and the colour value of the light emitted by gasfilled lamps. On this apparatus the lamps can be tested by means of Wratten screens of predetermined value, which are supplied by the National Physical Laboratory. Siemens gasfilled lamps are, therefore, very accurately tested in respect of rating limits, and the manufacturing specification adopted in the factory embodies all the conditions outlined in the British Engineering Standards Specification.

The lamps are fitted with caps on a radial machine, which allows of a number of lamps being dealt with at the same time.

Great stress is placed on the testing and examination of parts in every process of manufacture, and special attention is given to the final test. Every completed lamp before it leaves the factory is thoroughly tested in all respects to ensure accuracy of performance, according to the ratings marked on the lamp, and to eliminate any lamps in which minor mechanical defects may have occurred during handling.

In addition to this, many thousands of lamps of all types and ratings are tested to destruction, in order to obtain definite proofs of the average life of lamps produced in the factory.

The lamps are not stored at the Dalston factory, but are immediately transferred to the commodious stores owned by the company at 89a, Shacklewell Lane, which have a floor space of 46,000 sq. ft.

Numerous examples of special lamps have been designed and manufactured at the Siemens Dalston Lamp Works, each representing a large amount of experimental and pioneer work. Amongst these may be mentioned the projector type gasfilled lamps (vertical and horizontal grid patterns, tubular pattern, and special type for kinematograph lanterns); gasfilled head-light lamps for railways; the "Sylvalux" gasfilled lamp, with opalescent bulb to screen the filament, but with the absorption factor reduced to the minimum; and the "daylight" lamp (gasfilled), which without the aid of reflectors or expensive fitments is claimed to give a light of the consistency of sunlight, in which colours can be accurately matched. A special lamp of high candle-power was also made for the lantern of the Croydon aerial lighthouse pylon.

An interesting feature of the factory is the use of automatic machines for a great variety of operations, some of which one would have thought impracticable by machinery, such as the spider-making automatics, which, with several other devices, were designed and made entirely by the company's own staff. The impression left upon us was that the factory was thoroughly up-to-date and run on scientific lines—two qualities which are essential to success in the manufacture of electric lamps.

LEGAL.

Fined for Altering an Electric Meter.

At Colchester, last week, William Godfrey was charged with wilfully and fraudulently altering, by putting it back 50 units, the index to a meter for measuring the supply of electricity, which had been installed by the Corporation at the "Sea Horse" Hotel.

Defendant pleaded guilty.

It was stated that the defendant had been in the employ of the Corporation as a meter fixer for some time. In January the meter at the "Sea Horse" was found to be not as it should be, and a Mr. Tracey on January 20th put upon it a special seal with a special mark. In February, when examination was again made, it was found that the seal had been removed and replaced by another one. Inquiries were made, and the tools of the Corporation employés were examined. On the seal were found marks that corresponded to defendant's tools.

Defendant had nothing to say, and the Bench imposed a fine of £5.

Mrs. Ethel Rosa Haskins, wife of the licensee of the "Sea Horse," was then summoned for counselling and procuring the commission of the offence. She pleaded not guilty.

Godfrey said that he went into the "Sea Horse" as a customer, and while he was there Mrs. Haskins asked him to put the meter back, which he did. She afterwards gave him a drink and a packet of cigarettes.

The Bench found the case proved and imposed the maximum penalty of £5.

Westminster Electric Supply Corporation v. Wykeham Studios, Ltd.

This case, which raised the question of what rate should be paid by photographers obtaining electricity for business purposes, was decided by Mr. Justice Swift in the King's Bench

Division on Monday, May 22nd. Previous hearings were reported in our last issue.

Mr. Justice Rigby Swift, in the course of his judgment, said the defendants contended that in law the plaintiffs were not entitled to charge them at the rate of 3d. or 4d. per unit in the Midsummer, Michaelmas, and Christmas quarters for certain electricity supplied, and contended if they had charged at the rate of 2d. per unit, which was all they were legally entitled to do, they had been paid in full.

The defendants had for some years been in the habit of using electricity for a photographic arc lamp, and it was admitted that the electricity, for the price of which this action was brought, had been used by the defendants for purposes other than general illuminating purposes. The plaintiffs sought to charge the defendants at a higher rate than the maximum rate stated by them to be payable for electricity used for power purposes, and the defendants objected that the current, having been used for power purposes, that was to say, for purposes other than lighting, and through a separate meter—they were not liable to be charged more than the maximum rate for power purposes.

His Lordship found as a fact that the electric current used by the defendants, for the price of which the plaintiffs claimed was used by the defendants for power purposes and not for lighting, and that it should be charged for at the power rate and not at the lighting rate. This, however, did not dispose of the action, for the plaintiffs contended that even if they were under the circumstances compelled to treat the defendants as taking electricity for power purposes only, they might still charge them at the rates which they had charged in this action, that was to say, 7d. per unit for the quarters ending Midsummer and Michaelmas, and 4d. for the quarter ending at Christmas, 1921. The right of the plaintiffs so to charge was dependant upon the construction of secs. 19 and 20 of the Electric Lighting Act, 1882. By sec. 19 it was provided that where a supply of electricity was provided in any part of an area for private purposes, then, except in so far as was otherwise provided by the terms of the licence order or special Act authorising such supply, every company or person within that part of the area should on application be entitled to a supply on the same terms on which any other company or person in such part of the area was entitled under similar circumstances to a corresponding supply. Section 20 provided that the undertakers should not in making any agreements for a supply of electricity show any undue preference to any local authority, company, or person, but, save as aforesaid, they might make such charges for the supply of electricity as might be agreed upon, not exceeding the limits of price imposed by, or in pursuance of, the licence, order, or special Act authorising them to supply electricity. The meaning of these two sections had been discussed in four cases, to which his attention had been called; the Metropolitan Electric Supply Co., Ltd., *v.* Ginder, 1901; the Attorney-General of Victoria *v.* the Mayor, Aldermen, Councillors, and Citizens of Melbourne, 1907; the Attorney-General *v.* Long Eaton Urban Council, 1914; and the Attorney-General *v.* Hackney Borough Council. He thought the result of these decisions was that where current was supplied on two different systems, the choice of which was left to the consumer, there was no infringement of secs. 19 and 20, and that as between customers for each system the undertakers were entitled to differentiate as to price provided that the special circumstances of each customer were had regard to. But it was contended that in this case the defendants, using the current for power purposes, had been charging more than the rate which was fixed and advertised by the plaintiffs as being the rate for current supplied for power. He did not see why this should not be done if regard was had to the special circumstances of those who were charged at the higher rate, and if a proper differentiation could be made between them and others who were being supplied with current for power purposes in the same area. Provided that the undertakers did not charge more than the amount which was fixed by the Act, or which for the time being was agreed upon between them and the consumer, he could not see why they should not be allowed to charge a consumer more if the circumstances under which he was taking power were not similar to those of other persons who were taking it. In this particular case the photographers, speaking generally, were not taking current for power purposes under similar circumstances to other manufacturers. Their lamp was not burning regularly and for fixed hours during the day or night, but it was intermittently used as occasion necessitated for the taking of particular photographs, and he thought that the undertakers were entitled to say that, although their ordinary charge to persons using current for power purposes was 2d. per unit, they would charge a higher rate to persons who took current for use in a photographic arc lamp. He, at any rate, saw nothing in the sections to which he had referred, and as they had been construed by the Courts in the cases he had mentioned—which was inconsistent with that view. It was clear that the plaintiffs were under no agreement to charge the defendants other than the rates which they did, and the defendants had ample notice of the rates which they would be charged if they took the current. All photographers in the area using this supply had been treated in the same way, and he saw no reason for holding that the defendants, taking this current, with notice that they would be charged for it at the rates which they had been charged, should be relieved from payment of those rates. Under all the circumstances there must be judgment in favour of the plaintiffs for the amount claimed, with costs.

Charles Semon & Co., Ltd., *v.* Bradford Corporation.

Mr. Justice Eve, on May 17th, concluded the hearing of an action brought by plaintiffs, stuff and wool merchants, of Bolton Road, Bradford, against the Corporation, to restrain the latter from erecting an electric power station on the south side of Balme Street, so as to interfere with the lighting of plaintiffs' warehouse on the north side of the street. Mr. Hughes, K.C., and Mr. Bennett were for plaintiffs, and Mr. J. H. Cunliffe, K.C., Mr. Tomlin, K.C., and Mr. Woods for the defendant Corporation.

Mr. Hughes, K.C., in opening, stated that the plaintiffs' warehouse was situated at the corner of Bolton Road and Balme Street, and was erected on what was originally Corporation land, which was acquired by plaintiffs' predecessors. The Corporation's proposal to build the electric power station on the south side of Balme Street would seriously interfere with their business by diminishing the amount of northerly light, which was a most essential element in matching the various shades of dye colours of various pieces of cloth. The plaintiffs' warehouse consisted of a building of six floors with 36 windows, and on the opposite side of Balme Street at the present moment were only low buildings. The Corporation's proposed electric lighting station would be 73 ft. high, and this would seriously affect the lighting of plaintiffs' ground, first, and second floors. As a rule an angle of 45 degrees was usually taken in buildings of this character, but in the present case the Corporation's electric station would be only 34 degrees.

Mr. Walter Jackson, architect and surveyor, stated that the Corporation's electric station would take a very large proportion of the plaintiffs' northerly light, as much as 55 per cent. on the ground floor, 51 on the first, 44 on the second, and 34 on the third floor. The property would be greatly depreciated in value.

Sir Bannister Fletcher, architect and surveyor, stated that when the electric station was built the plaintiffs' two easterly windows on the three lower floors and the other windows on the same floor would be affected, especially as regarded indirect and diffused light generally.

Mr. Cunliffe, K.C., for the defendants, said the plaintiffs seemed to think they were entitled to a special light, but what quantity or quality of light they wanted was difficult to say. The case for the Corporation was that the plaintiffs would only be slightly affected, and that when the power station was erected they would still have a good and effective light for the carrying on of their business. They would be in a far better position after the building was erected than many other firms in Bradford in the same trade. It could not be admitted for a moment that the development of Bradford in respect of electrical supply should be stopped on this question of lighting.

Mr. Percy John Waldram, engineer and surveyor, said that when the power station was erected the plaintiffs' warehouse would still be distinctly above the average for light.

Several other experts expressed the same view, and his Lordship reserved judgment.

Is a Tramcar a Carriage?

Last week the Bradford Stipendiary Magistrate heard a case demanding a ruling as to whether an electric tramcar was a "carriage" within the meaning of the Town Police Clauses Act, 1847, and as such should be passed by motorists on the "off" (right hand) side, except when there was actual necessity or sufficient reason for deviation permitting passage on the near side. The case was one in which Sidney D. Goldthorpe, a Halifax motor-haulage contractor, was summoned, in respect of a collision with a laundry van when he passed a Bradford tramcar on the near side. The laundry van was crossing the road in front of the tramcar. The Stipendiary Magistrate gave his judgment on Friday, and quoted a High Court decision on a previous Bradford case (Burton *v.* Nicholson), under the Motor Cars Order, 1904. He ruled that a tramcar was a "carriage" within the meaning of the law, and that it was the duty of the motorist to pass on the right hand side, unless there was good reason for deviation. In the present case, however, there had been good reason for passing on the left-hand side, as there were two tramcars passing each other in opposite directions, as well as the overtaking motor car and the crossing laundry van. The summons, therefore, was dismissed.

Copper Cooling Coils for Transformers.—Iron pipes are often used for the cooling coils of water-cooled transformers, and it has been found that they are liable to give trouble through rust, &c. To prevent this the Westinghouse Electric and Manufacturing Co., U.S.A., has decided to supply only copper coils, without increase in price.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Mangnall-Irving Thrust Borer.

Your correspondent, Mr. F. O. Trotman, makes some sweeping assertions in his letter to you on the Mangnall-Irving thrust borer in your issue of the 5th inst., and thinks it misleading to describe its use as an "improvement." I have just put two 1¼-in. screwed steel pipes across a main road, paved with wood blocks and with a double tramway track, by means of this apparatus. These are to accommodate a service line and a small high-pressure cable. The job was started at 10 a.m. and completed by 5 p.m., taking six working hours. The width of the roadway is 31 ft. 6 in. The cost has been as follows:—

	£	s.	d.
Labour (3 men, 6 hours)	0	19	9
70 ft. 1¼ in. steel tube	3	15	10
Re-instatement, 3 yd. super tar-mac	0	15	0
	£5	10	7

If the work had been done in the manner favoured by your correspondent the cost would have been:—

	£	s.	d.
Labour (4 men, 18 hours)	4	10	4
70 ft. stoneware duct, cement, &c.	4	7	6
Re-instatement, 5 yd. super wood blocks and 1 yd. super tar-mac	9	0	0
	£17	17	10

There has been a saving of 70 per cent. in the cost of the work, to say nothing of traffic obstruction, or of the permanent deterioration of wood block paving when it has been patched.

This may be a "particular case," but I meet scores of such particular cases in the course of a twelvemonth, and I suggest that this is an improved method of dealing with them.

There is no virtue in a lead-jointed pipe if a screwed and socketed pipe can be laid more cheaply, and not a great deal in tiles, bricks, or creosoted wood boards as a protection to armoured cables. There is more protection in laying them another foot or 18 in. deep, and this can be done at the trifling cost of getting out the bore pits to that much greater depth.

Edgar Ll. Ingram.

Parkstone, Dorset.
May 15th, 1922.

My notice has just been called to Mr. F. O. Trotman's letter to you on the above subject in your issue of May 5th. Mr. Trotman's main point appears to be that he disapproves of the title "An improved method of cable laying," given to your excellent article of April 21st last, on the ground that the word "improved" is misleading. As Mr. Trotman looks at this from a mains engineer's point of view, I beg to suggest that he should get into touch with the mains engineer of his own town—Sheffield—where a machine has been in use daily for the last 3½ months. He would then be able, no doubt, to obtain all the information he requires as to how the Sheffield cables are laid by thrust-boring.

The point raised of not being able to make an iron pipe tight at the joint is, of course, absurd. High-pressure gas services have been laid in a great many cases in quite difficult ground by actually using the lap-welded service pipe to take the load of boring, and these pipes on being subjected to the usual high-pressure test have shown not the slightest leakage of any kind. Caulked joints are, of course, quite unnecessary. Bitumen jointed earthenware sewer pipes in 12-in. boreholes have likewise been laid without leakage.

I suggest that Mr. Trotman might accept your title of "an improved method of cable laying." For instance, it would be untrue to suggest that wireless telegraphy and telephony are not improved means of communication on the ground that their application in certain cases is inconvenient. There is a growing tendency to lay armoured cables direct in the ground without any form of pipe protection.

A. R. Mangnall.

Chester, *May 20th*, 1922.

Referring to Mr. F. O. Trotman's letter in your issue of May 4th, may I point out that the laying of mains by this method is not restricted to cables drawn through iron piping.

Obviously, a conduit whose overall diameter at the joints is not greater than that of the conduit itself is desirable, and any conduit complying with this can be easily pushed through the bore hole by means of an attachment to the withdrawal gear which is used for withdrawing the boring tubes.

The writer was present at some tests made by a Government department, in which Key fibre conduit with socket and spigot joints was employed; the overall diameter of the joints of this type of conduit is, of course, the same as that of the conduit itself. The joints are actually made in the thrust pit, prior to the introduction of each length into the entrance of the bore hole, by painting the ends with a bituminous solution, which sets very quickly, owing to the nature of the conduit, and is quite an easy matter.

As a matter of fact, for short runs, such as services, those ducts, which are very light, can be pushed length after length into the bore by hand, if the boring is made of sufficient diameter to allow for a little clearance.

A. R. Porter.

Trafford Park, Manchester,
May 22nd, 1922.

Private Electricity Supply.

On page 645 of your issue of May 5th is an interesting point dealing with private supply, and notwithstanding your official comment on this matter, I would like to suggest that in this case the owner of the property is not entering into the business of electricity supply as is generally understood, but is merely generating current for use on his own property. I gather that you are of the opinion that it would be a business in the sense described in the 1909 Act, but to me there just seems to be a doubt as to whether this is strictly correct.

The point, I believe, will be of interest to several consumers throughout the country, and if you can amplify your comments on the matter, I feel sure it would be much appreciated by others as well as

Doubtful.

May 16th, 1922.

[We cannot recall any case in which the question whether "the business of the company or person affording the supply is not primarily that of the supply of electrical energy to consumers" (Electric Lighting Act, 1909, Clause 23) has come before the Courts; but we take it that the proviso refers to cases where a person has a surplus of electricity available, which he is at liberty to sell to consumers. In the present instance, the plant is to be put down specially to supply consumers, and the fact that those consumers are tenants of the supplier does not affect the question—they are members of the public; the plant is to be used solely for this purpose, and, in our opinion, the business would not be covered by the proviso.

However, if the local statutory undertaker consents, the way is open, for the Electricity Commissioners have now removed all restrictions on supplies up to 50 kW.—Eds. Elec. Rev.]

Apply in Person.

A short time back we advertised in your Review for a driver of a cable-making machine. One answer which we had, read: "Will the advertiser please call at the above address and oblige."

We think this might interest some employers of labour.

Macintosh Cable Co., Ltd.
Percy W. Sankey.
Liverpool, *May 16th*, 1922. *Works Manager.*

Civil Service Examination for Post Office Engineering Inspector.

I think some good might be done if you published the following facts about the above examination, which was advertised in your issue of the 12th inst.

The examination is fixed to start on July 13th. The final examinations of the London University take place during part of the same period. For instance, the B.Sc. (Engineering exam. starts on the 3rd and finishes on the 14th July. Surely this could be avoided. I am sitting for the B.Sc. (Eng.), and also wish to take the Inspectorship examination, which, at present, I cannot do. No doubt there are many others in a similar position.

The age limit is 22, with a maximum of two years deduction for army service. Why should those who voluntarily spent more than two years in the army be thus handicapped? The regulation seems to me to have been made for the benefit of "dodgers." Personally, I spent 3½ years in the army, so I suffer to the extent of a year and a half.

The publicity which the above could receive through the Electrical Review would surely cause the Civil Service Commission to take a more reasonable view of the matter.

A Might-be Entrant.

May 15th, 1922.

Does the Institution Need a Wider Outlook?

On several occasions, after some years' residence abroad, I have, on coming home, been struck by the insular parish-pump point of view that characterises meetings of the Institution of Electrical Engineers. Naturally, having its origin in Great Britain, the *happenings here* must loom large at

the meetings and in the proceedings, but the Institution has now widened its activities to all parts of the British Commonwealth, and, moreover, it is concerned with a branch of engineering that has a world-wide appeal. I think, therefore, that matters that happen *outside* the British Isles should receive more attention than they do, and also that speakers in the discussions might endeavour to see things in a *broader* way.

Readers may have noticed that the Institution of Civil Engineers is as much interested in engineering abroad as in what happens at home, and the proceedings of the I.C.E. contain many papers descriptive of engineering work in all parts of the world. Partly as a result the membership is very widespread.

Engineers as a class travel a great deal, and large manufacturing concerns are as much interested in orders from overseas as they are in local orders. The Institution membership must, therefore, contain many members who think as I do.

I suggest that a suitable leaven of engineers now resident in this country, who have lived in some particular country overseas long enough to know intimately actual conditions, should be introduced into the British Council in order to ensure that the proceedings of the Institution shall in future have that wider outlook which several observers, as well as myself, feel that it needs.

E. Kilburn Scott.

London, N.1.
May 16th, 1922.

A Tragedy in Trousers.

Among your "Situations Vacant" advertisements, a week or so ago, appeared "Lady Shorthand-Typist wanted," and I applied, although I am, owing to circumstances over which I had no control, a man.

This morning I received a polite request for an interview, with which I graciously complied, but apparently my letter hadn't made it sufficiently clear that I wear a skirt round each leg, because the man who interviewed me appeared both surprised and annoyed, and suspicious and aggrieved, and told me almost immediately that I was no lady, with which I agreed—and I then went on to point out that in addition to being a first-class stenographer I was throwing in my technical knowledge (I do estimating when not resting), which would, at least have saved them the trouble of correcting those "typists'" errors, the removal of which has taken some of the best hairs of my life.

In spite of all this, and the fact that the screw I asked was within their limit—or they wouldn't have written—I could get nothing better than "we—er—have always been used to lady typists—and—er—in fact, that is what we always have had, and—er—we've got so used to lady typists that—er—in fact I'm afraid we've always had lady typists." (Luckily the æsthetic aspect wasn't even mentioned).

No real objection at all, except that I belong to the sex that reasons and pokes fires from the bottom, and had I been only partially attired, clean shaved, and had my voice ironed I could have had the job.

Apart from the daft conservatism shown by such an attitude, will anyone tell me what earthly reason there can be for denying work to a man who needs it because he is one?

As a friend of mine in a sober interval the other day remarked to the lady who was drawing his lunch: "If they'd only shut all the pubs, stop all the horses and shoot all the women, this'd be a fine world."

But perhaps somebody will start another war soon, and then we'll all have a job.

W. A. C. Phillpot.

London, *May 19th*, 1922.

Broadcasting Wireless Telephony.

As a manufacturer of telephone and telegraph apparatus I am anxious to take part in the coming rush of orders for wireless telephone sets which the daily papers are now boosting. I have spoken to one or two friends in the trade, but have been told that the monopoly of the manufacture and sale of receiving sets will be in the hands of Marconi's and one other firm. I am curious to know what will happen to numerous small firms now advertising complete receiving sets from £6 upwards. Will they be forced to close down through Marconi's monopoly, or will the small manufacturer be able to execute orders for this class of work?

I should be glad if you could enlighten me in this direction, which will also assist other small manufacturers.

Tuner.

May 19th, 1922.

[We are not aware that any such monopoly exists, or can exist.—EDS. ELEC. REV.]

Turbine or Waterwheel?

I am interested in a small water turbine of about 8 h.p., working under a head of 14 ft. Much trouble has been caused by the accumulation of leaves in the turbine during the autumn months, and I should be glad to have the experience of your readers as to whether a water wheel would not be more satisfactory.

For a given head and quantity of water, I should be glad to know how a waterwheel of similar power would compare as regards efficiency, and further, whether a waterwheel can be used satisfactorily to drive a dynamo.

Any information from readers who are operating small plants of this nature would be much appreciated by

Waterwheel.

The Lead-hydrate Battery.

Replying to your correspondent Mr. B. W. Gothard, the above must be a wonderful battery!

Assuming that the battery can be charged at 300 times the normal rate, what sensible person is going to the expense of a plant to give this output?

There are evidently other "Canadian Wonders" besides the type of bean known by that name! and, perhaps, the battery will last as long as the bean.

J. N. S.

Manchester.

Fans and Fancies.

So far, the retailers do not appear to be making much of a show with regard to fans, an excellent selling line in this weather.

The average table fan consumes no more energy than a lamp, and it might very well be shown in a window against a 50-watt lamp with some statement to that effect.

A fan on a bracket in the doorway with a few ribbons, or any simple device of that kind to remind the weary passer-by of the comfort to be obtained so cheaply with an electric fan, should surely stimulate business. It is possible to devise many attractive window fit-ups with the fan; now or never is the time.

J. W. Beauchamp,
Director and Secretary,
British Electrical Development Association Inc.

London, *May 23rd*, 1922.

Wireless Position-finding for Aircraft.—Since October of last year a wireless "position-finding" system has been under trial to enable air pilots to ascertain their position when flying on the cross-Channel airways. We are informed by the Air Ministry that this system has, on several occasions, proved to be of particular advantage in adverse weather conditions, and has been introduced as a regular feature of the civil aviation wireless service. It is a further development of wireless direction finding. Until last October direction finding work was carried out only by the civil aviation wireless station at the London Air Port of Croydon, and was limited to giving a pilot his compass bearing from that station. The direction-finding station at Pulham Airship Base, Norfolk, has been successfully operated as the second station of the system during the past six months, thus enabling two bearings to be taken simultaneously upon a single aircraft, and its position determined by plotting the bearings upon a chart, the point of intersection giving the aircraft's position. Direct intercommunication between Croydon and Pulham is effected by radio-telephony, and the pilot can be informed of his position with a high degree of accuracy under normal conditions. The radius of action for giving position is approximately 200 miles from the control station, which in this case is Croydon. Although primarily designed for radio-telephony, the system is equally adaptable for radio-telegraphy; the change over being carried into effect by a simple switch in a few seconds. The position can normally be given within two minutes. Similar facilities can be afforded from Croydon to aircraft engaged on inland flights and services. In February last an aeroplane flying over the airway between Paris and London was navigated entirely by wireless, the pilot seeing the ground only on one occasion for a few minutes.

A Postage Meter.—The Postmaster-General has authorised the Pitney-Bowes postage meter for general use, says the *Westminster Gazette*, which dispenses with adhesive stamps. Letters of any size are fed into the instrument electrically at the rate of 250 per minute, and sealed, stamped, cancelled, dated, timed, and stacked ready for packing into bundles, if necessary.

A detachable meter registers impressions up to 300,000 at one charging, and then stops automatically. For recharging, one takes the meter to the nearest post office, pays for the number of stamps required, and it is readjusted for further use by an official who holds the only key. A separate meter is required for each value of stamps, and this can be changed instantly. A cheaper handworked machine may be used for smaller business. The immediate saving in time and trouble is obvious. Over 300 of these machines are in use in the United States. The Universal Stamping Machine Co. sees infinite possibilities in its applicability.

BUSINESS NOTES.

Engineering at the British Empire Exhibition, 1924.—We have already announced that the arrangements connected with the Electrical Engineering exhibits at the 1924 Exhibition are in the hands of the B.E.A.M.A. and under the direction of a special committee, representing all branches of the electrical industry. We understand that full particulars will be available for electrical manufacturers and other intending exhibitors almost immediately.

We are now informed that the British Engineers' Association has been entrusted with the task of organising the Shipbuilding, Marine, Mechanical, and General Engineering Section of the Exhibition. The work of organising this section and allotting space therein will be controlled by a special committee composed of the President and Council of the Association and a number of independent representatives of the engineering industry. Within the limits of the space available—about 238,000 square feet—every effort will be exerted to make the engineering exhibits representative of all that is best in modern British practice. Full particulars, plans, and forms of application for space will be available for issue at an early date. Inquiries should be addressed to Mr. D. A. Bremner, Director, The British Engineers' Association, 32, Victoria Street, London, S.W.1.

Bankruptcy Proceedings.—W. Francis, electrical engineer, 4, Prospect Place, Cheam, Surrey.—Receiving order made May 16th on creditor's petition. First meeting May 30th, at 29, Russell Square, W.C. Public examination June 21st, at the County Court, Croydon.

Albert Ralph Gibbons, 8, The Parade, New Eltham, Kent, electrical engineer.—The first meeting of the creditors of the above was held on May 22nd, at 29, Russell Square, W.C.1. The statement of affairs showed liabilities of £587, and there were no assets. Debtor attributed his failure to depression in trade, depreciation of stock, losses on contracts and unremunerative wages paid. It appeared that for 8 years prior to 1914 he carried on business as an electrician and automobile engineer, at Tunbridge Wells. In March, 1919, he started business at his present address as an electrical and automobile engineer, with £90 capital. The business was successful until about March, 1921, when there was a depression in trade, and he was under the necessity of retaining a number of skilled workmen for whom he had not full remunerative employment. Since September, 1921, the creditors had pressed for payment, and in December, 1921, a creditor obtained judgment for £145. The only books of account kept were a creditor's ledger and cash book. The matter was left in the hands of the Official Receiver as trustee of the estate.

The following are creditors:—

	£		£
Brown Bros., Ltd.	77	Siemens Bros. & Co., Ltd. ...	110
British Pure Oil Co.	26	Siemens & Co., Ltd.	26
Smith & Co., B. W.	12	Siemens & Co., Ltd.	24
Calmont, King & Co.	14	White, Andrew & Co.	15
District Times, Ltd.	30	Wenham Lighting Corporation...	18
Hutchinson Motor Engineers ...	15	Falk, Stadelmann & Co., Ltd. ...	150

George Hill, George Noble, and Edgar Cowley, trading in co-partnership as George Hill & Co., 22, Chantry Lane, Great Grimsby, electrical engineers. The following are creditors herein:—

	£		£
Beadle & Co., Ltd.	14	General Electric Co., Ltd. ...	67
Dawson & Colda	30	Metropolitan-Vickers, Ltd. ...	19
Edison Swan Electric Co. ...	34	Siemens Bros.	88
English Electric & Siemens Supplies, Ltd.	25	Smith, W. H.	11

Reginald Silver Magson, trading as R. S. Magson & Co., 10, Stoney Stanton Road, Coventry, electrical engineer.—The receiving order in this matter was made on May 11th, on debtor's own petition. The statement of affairs shows liabilities of £497, while the assets are estimated to realise £286, from which preferential claims of £2 14s. 11d. have to be deducted, leaving net assets of £283, or a deficiency of £213. Debtor attributes his failure to illness of self and family. It appears that he commenced business in March, 1912, at his present address, as an electrical engineer, his capital consisting of £20 cash saved. Shortly afterwards he borrowed £40 as additional capital, which has since been repaid. He became aware of his position about four months ago. First meeting, May 31st, at the Official Receiver's office, The Barracks, Coventry; public examination, June 12th, at the County Hall, Coventry.

Frederick Ridgway and Thomas Tynan, trading as Ridgway & Tynan, 21, Bowling Old Lane, Bradford, electrical engineers.—The first meeting of creditors was held recently at the Official Receiver's offices, 12, Duke Street, Bradford. The statement of affairs showed gross liabilities of £439, of which £432 was expected to rank for dividend, against net assets of £79, or a deficiency of £353. The matter was left in the hands of the Official Receiver as trustee.

E. W. Morgan, company director and electrical engineer, Eccles Mill, Monton Lane, Eccles, Lancs.—Receiving order made May 17th on creditor's petition.

G. F. Coupe, electrical engineer, 2, Spring Gardens, Stockport.—Receiving order made May 13th on debtor's own petition. First meeting, May 31st, at the Official Receiver's offices, Byrom Street, Manchester; public examination, June 13th, at the Court House, Stockport.

A. Kershaw and C. H. Wood (Kershaw & Wood), electrical engineers, 9, Bradford Road, Dewsbury.—Order for discharge granted April 5th, subject to consenting to judgment of £200 and 30s. costs being entered (payable £25 per quarter).

E. E. Mathers, electrical engineer, 10c, High Street, Doncaster.—First and final dividend of 11½d. in the £, payable at the Official Receiver's offices, 14, Figtree Lane, Sheffield.

A. V. Clayton (Clayton Motors), engineer, Park Lane Mills, Chorley Lane, Leeds.—First meeting May 30th, at the Official Receiver's offices, Leeds. Public examination June 27th, at the County Court, Leeds.

Charles Archibald Henderson, merchant, 63, Queen Victoria Street, E.C.—The first meeting of creditors under this failure was held on Monday at the London Bankruptcy Court. The debtor, who dealt in insulating materials, returned liabilities £22,000, against assets valued at £1,954, excluding the equity of a freehold house at Sutton. The meeting had stood adjourned to enable the debtor to submit a proposal, but the estate was now left in the hands of the Official Receiver.

Nathan Prins, dealer in electrical accessories, 74, Forest Road, Dalston.—This debtor attended on Tuesday at the London Bankrupcty Court, before Mr. Registrar Mellor, for public examination upon accounts showing liabilities £144, against assets of £6 15s. He stated, in reply to Mr. Warren, Official Receiver, that he was a Dutch subject, and came to this country in 1912 when 12 years of age. In 1919, without capital, he commenced to deal in electrical accessories on his own account, and traded until the receiving order was made against him last March on a creditor's petition. Witness attributed his failure to bad trade and depreciation in the value of his stock in trade. The examination was concluded.

Company Liquidations.—A. T. Kremers Manufacturing Co., Ltd.—A petition for the winding-up has been presented to the High Court by Bronzefarbenwerke A.G., of Kempten, Switzerland, and will be heard in London on May 30th.

A. Leonard & Co., Ltd.—Winding up voluntarily. Liquidator: Mr. E. F. Jones, 4, Fenchurch Avenue, E.C. Meeting of creditors June 2nd, at the Institute of Chartered Accountants, Moorgate Place, E.C.

Corona Lamp Works, Ltd.—A petition for the winding-up has been presented to the High Court by the British Thomson-Houston Co., Ltd., electric lamp manufacturers, of Crown House, Aldwych, W.C., and will be heard in London on June 13th.

Park Bros., Ltd., electrical engineers, Spring Bridge Road, Ealing, London, W.—The creditors were called together on May 19th, at the offices of Messrs Corfield & Cripwell, accountants and auditors, Balfour House, Finsbury Pavement, E.C. Mr. W. A. J. Osborne, the liquidator in the voluntary liquidation of the company, submitted a statement of affairs which showed liabilities of £277, all of which were due to the trade. The assets were estimated to realise £119, or a deficiency of £158. Book debts of the face value of £73 were written off as bad.

Mr. Osborne stated that the stock included a quantity of old material which would be very difficult to dispose of. The business was an old-established one, and was previously carried on under the style of Park Bros. It was converted into a company in December, 1900, with a nominal capital of £1,000, of which £334 represented preference shares and £660 ordinary shares. The vendors received 603 ordinary shares as the purchase price of the business, while 250 preference shares had also been issued. For some years the business was successful, but during the last three or four years there had been losses on the trading. Efforts had been made to introduce further capital, but without success.

The creditors passed a resolution confirming the voluntary liquidation of the company, with Mr. Osborne as the liquidator.

S. Gillitt & Co., Ltd.—A petition for the winding-up has been presented to the County Court of Northumberland, by English Electric and Siemens Supplies, Ltd., and will be heard at the Court House, Newcastle-on-Tyne, on June 15th.

North British Diesel Engine Works, Ltd.—Winding up voluntarily. Liquidator: Mr. H. J. Lane, Winchester House, E.C. Meeting of creditors at the offices, South Street, Whiteinch, Glasgow, June 6th. Particulars of claims to the liquidator by June 27th.

Dissolutions of Partnership.—Wireless Equipment Co. for the Manufacture, Sale and Exchange of Electrical and Wireless Instruments and Material, 22, Park Road, Collier's Wood, Merton, S.W.—Messrs. H. S. Walker, J. A. Partridge, and F. A. Mayer have dissolved partnership. Debts will be attended to by Messrs. Walker & Partridge.

Caig Bros. & Jones, electrical engineers, 61, Renshaw Street, Liverpool.—Messrs. F. S. Green, J. D. Caig, and A. Caig have dissolved partnership. Debts will be attended to by Messrs. Caig, who will continue the business.

Deed of Assignment.—J. N. BARDSLEY, plumber and electrician, 179, Katherine Street, Ashton-under-Lyne.—Particulars of claims by May 31st to the trustee, Mr. A. T. Eaves, 15, Fountain Street, Manchester.

Trade Announcements.—MR. FRANCIS COOPER, electrical engineer, Wollaston, has opened a branch shop at High Street, Wellingborough. He desires to receive catalogues.

MESSRS. PLANT & SUPPLIES, LTD., of 12 and 13, Henrietta Street, London, W.C.2, have purchased the business of Mr. Ashley Pope, Toddington, near Dunstable, and he has been appointed managing director. The company are the sole agents and distributors for London, the Home Counties, and Southern England for the "Sceando" lamps.

The London office of the HOFFMANN MANUFACTURING CO., LTD., has been removed from 59, New Oxford Street to 8, Bedford Square, W.C.1. Telephone number and telegraphic address unaltered, viz.: "529 Museum" and "Hoffmannly, Westcent." All branch offices are, we are informed, staffed by experienced engineers, and stocks of the company's bearings are carried.

MESSRS. WARD & GOLDSTONE, LTD., announce that in order to cope with their increasing South of England business, they have opened extensive premises at 8a and 9, Great Chapel Street, Oxford Street, W.1 (three minutes from Tottenham Court Road Tube station), where they are carrying varied stocks for wholesale customers. Mr. J. S. Child (ex-joint sales manager to the Edison Swan Electric Co., Ltd.) has undertaken the company's representation for London and district, and all orders for this area will in future be dealt with from the above London depôt.

MR. R. J. WILMOT, secretary to the A. & A. Electrical Co., Ltd., has resigned from that firm in order to take up his appointment as secretary to the L.F.A., Ltd.

MR. ERIC TOFT having retired from the firm of Radford and Toft, electrical engineers, of 8, Station Buildings, Altrincham, Cheshire, the business will be continued by Mr. Luke Radford under the style of L. Radford & Co.

MR. E. F. TURNER, for many years works manager for Brind, Gillingham & Co., has commenced business as an electrical engineer at 20, Banbury Road, Oxford.

Mr. F. KENT, who was formerly with Messrs. Crompton and Co., Ltd., has been appointed manager of a branch business at Priory Road, High Wycombe, established by Walters, Dobson & Co., electrical and general engineers, of Sheffield.

The London office of MESSRS. W. H. ALLEN, SONS & CO., LTD., has this week been moved to 5, Victoria Street, Westminster, London, S.W.1.

MESSRS. CALLENDER'S CABLE & CONSTRUCTION CO., LTD., are this week removing their central office for Scotland from Stirling to 23, Melville Street, Edinburgh.

MESSRS. MAWDSLEYS, LTD., of Dursley, have appointed Messrs. E. A. Ingold, Ltd., of 129, Otley Road, Shipley, to represent them in Yorkshire.

MR. DUNCAN WHITE, late with Messrs. Brooks & White, has joined the Hotpoint Electric Appliance Co., Ltd., 21, Berners Street, London, W.1.

MESSRS. G. S. PECKHAM & CO., of 4 & 5, New Compton Street, Charing Cross Road, London, W.C.2, have been appointed London and South of England sole agents for the Patent Flexible Belting Co., Eldwick, Bingley, Yorks., for the sale of its new flexible leather belting.

Catalogues and Lists.—MESSRS. JOHNSON & PHILLIPS, LTD., Charlton, S.E.7.—An illustrated pamphlet describing transformer-oil testing equipments. "Transformer Abstracts" No. 9. This deals with the current distribution with interconnected-star static balancers and is fully illustrated with diagrams.

THE REES ROTURBO MANUFACTURING CO., LTD., Wolverhampton.—Catalogue R. 197, giving particulars and numerous illustrations of rotary jet condensers and vacuum pumps.

ALLIED NATIONAL CORPORATION, LTD., 72-74, Queen Victoria Street, S.W.1.—An illustrated and priced catalogue of transformers manufactured by Le Transformateur (S.A.), Paris, for which the Corporation is agent. Also several price lists of oil switches, line insulators, and other apparatus made by the French firm, La Métallurgique Electrique.

THE EDISON SWAN ELECTRIC CO., LTD., Ponders End, Middlesex.—Eight illustrated and priced leaflets dealing with insulation and combination testing sets, moving iron and moving coil instruments, galvanometers, &c.

MESSRS. JOHN PHILLIPS & CO., 166, Walworth Road, S.E.17—An illustrated pamphlet describing a commutator-mica notching machine.

MESSRS. GEORGE NORBS, LTD., 89, Cleveland Street, Fitzroy Square, W.1.—Leaflet Y204, an illustrated description of "Genii Push System" electric water heaters.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—Catalogue Section X (5), an illustrated price list of electric motor starters of many types, d.c. and a.c., with particulars of pedestal mounting; also a description and photographs of the electric lighting of the "Norwich Picture House."

SUPERLAMP, LTD., 197, Old Street, E.C.2.—A leaflet advertising the "Lesradio No. 1" wireless telephony receiving set.

CALLENDER'S CABLE AND CONSTRUCTION CO., LTD., Hamilton House, Victoria Embankment, E.C.4.—An illustrated booklet describing the "Kaleeco" wiring system.

MESSRS. SIEMENS BROS. & CO., LTD., Caxton House, Westminster, S.W.1.—An illustrated and priced pamphlet dealing with primary cells and batteries for use on the h.p. circuit of wireless apparatus employing thermionic valves.

A booklet entitled, "The Reflections of a Commercial Studio," has been received from MESSRS. GREENLYS, LTD., 37-38, Strand. It is printed in colour, and gives specimen designs for letter-headings, folders, booklets, catalogues, showcards, and Press advertisements. A lengthy list of firms for whom Greenlys have executed work of this description is given at the end.

THE ZENITH MANUFACTURING CO., Villiers Road, Willesden Green, N.W.2.—Leaflet ZM 55, giving prices and particulars of "Zenite" vitreous enamelled resistance units.

WELCO PATENTS, 50, Alma Street, Birmingham.—An illustrated folder, giving details and prices of electric fires, kettles, toasters, and other small domestic appliances.

THE BENJAMIN ELECTRIC, LTD., Brantwood Works, Tariff Road, Tottenham, N.17.—A series of illustrated leaflets advertising "Benjamin" automobile accessories—lights, horns, &c.

Staff Dinner.—On Friday last the London office staff of C.E.C., Ltd., held a dinner at the Mecca Café, Ludgate Hill, E.C., to welcome home Mr. and Mrs. Ellis on their return from a 13 months' tour of the world. Mr. Ellis (managing director), replying to his toast, explained that the whole 13 months of the trip had been devoted to seeking first-hand knowledge of trade conditions of the export market. He narrated illustrative anecdotes or incidents typical of Spain, South America, United States, Canada, Honolulu, New Zealand, Australia, Ceylon and India. After reviewing the industrial troubles in most of these countries, Mr. Ellis compared them with those of the home country, and said that unquestionably if he had to start life again he could choose nothing better than England. Of the Colonies he placed Australia at the top of the list for the settler, and Canada was noted as the most enterprising. The proceedings included a musical programme.

The Cost of Producing and Distributing Catalogues, &c.—High postal rates and printing costs have told against the production and distribution of a great deal of trade-getting literature, catalogues, price lists, trade journals, &c. Were these matters both settled satisfactorily so that reasonable charges and a stabilised printing trade were in existence, manufacturers and traders might be induced to proceed more enterprisingly with their business-seeking propaganda. Some reduction in the halfpenny postal rates comes into force on May 29th, and it is to be hoped that as the result of the movement in the printing trades those concerned will be able to come to an agreement which will be reasonable and acceptable to all parties. We are convinced that were such the case, in a short space of time, there would be such an increase of work as would absorb a good deal of the at present unemployed labour. Whatever may happen in the printing trades, however, it is as well not to overlook the immediate advantage that postal reduction alone should bring, and in this connection we may quote from a letter issued by the Association of Master Printers (London Central Districts), where it is pointed out that the new half-penny postal rate will carry any of the following:—

8-page catalogue (size 14 by 9½ in.)
16-page catalogue (size 10½ by 8¼ in.)
16-page catalogue (size 9¼ by 7 in.)
24-page catalogue (size 8 by 5½ in.)
32-page catalogue (size 8½ by 4½ in.)
36-page catalogue (size 7½ by 4½ in.)

These catalogues can be enclosed in envelopes or wrappers. The halfpenny rate enables industrial firms to send out millions of prospectuses, balance sheets, circulars, price lists, invoices, statements, order forms, market reports, acknowledgment forms (imitation typewritten circulars if handed to the Post Office in lots of not less than 20 copies). It also allows of a mailing card—that is, a printed matter card, minimum size 3½ by 5½ in. up to a maximum size of 12 by 24 in.

New French Company.—There has been formed at Paris (Rue de Vivienne, 8) a company under the style of Société Nouvelle d'Eclairage, Chauffage et Force Motrice de St. Germain-en-Laye et extensions. The objects are the working of public services for supplying electric lighting, heating, and power. Capital 2,600,000 fr. in 100-fr. shares, 15,000 of the 26,000 shares being paid as set-off for the assets of the Société St. Germainoise d'Eclairage et de Chauffage, which have been taken over.

G.E.C. Fan Propaganda.—The GENERAL ELECTRIC CO., LTD., in order to increase the sales of its "Freezor" fans, has arranged to give dealers free advertisement in the *Daily Mail*. Full particulars are contained in a brochure issued by the company.

Protecting the Buyer.—In order to protect buyers of electrical material against the supply of goods purporting to be made by well-known electrical firms when such is not the case, Simplex Conduits, Ltd., is arranging an advertisement in which the distinctive marks of leading electrical manufacturers are set forth.

Cardiff Engineering Exhibition.—The South Wales Institute of Engineers will be holding an engineering exhibition at the Drill Hall, Cardiff, from November 20th to 25th inclusive. The mornings will be occupied by conferences held at the Institute, in Park Place, and papers for discussion are invited. There will be six sections to the exhibition: (1) scientific instruments; (2) steam section; (3) electrical section (switchgear, cables, controllers, overhead lines, electrical tools, and other appliances, small motors, electric cranes, and telephone and wireless apparatus); (4) mechanical section; (5) workshop appliances; (6)) mining and general industrial section. Manufacturers who are desirous of taking part in the exhibition are requested to write to the secretary of the Institute, Park Place, Cardiff, for particulars and application forms.

Australian Tariff Decisions.—Among the tariff decisions approved by the Australian Customs Department are the following:—

Electric machines and appliances for the production and distribution of electricity from brown coal, including lightning arresters, frequency absorbers and parts thereof, switchgear, transformers, and other appliances used in connection with these machines. These may be admitted under item 174—free under the British preference tariff, 5 per cent. under the intermediate, and 10 per cent. under the general tariff.—*Reuter's Trade Service.*

Unemployment.—On May 8th the number of persons registered in Great Britain as totally unemployed was 1,587,000, being 29,682 fewer than a week previously. There was also a reduction of 27,281 in the number of workers on short time and drawing part benefits. The first total was further reduced by May 14th to 1,553,500, while short-time workers numbered 130,000.

All-Electric Canteen at Glasgow.—Members of the Corporation Electricity Committee participated in a pleasant function on Friday, when a tournament was held on the bowling green at Dalmarnock, recently opened for the season. At the conclusion of the games the party sat down to dinner, when the capabilities of the "all-electric" cooking plant installed at the canteen used by the employés were tested. Mr. R. B. Mitchell, engineer and manager of the Electricity Department, expressed gratitude for the gift of the canteen, and said he was sure the employés would give of their best in return for what had been done for them. The canteen is a commodious building, and the kitchen equipment represents the most up-to-date developments in electric cooking appliances. There are a treble-oven suite, intended principally for roasting and baking; a large boiling table; a fish-cooking service; three hot-plate cupboards; hot water and soup urns; a tea and coffee infuser; and other appliances for various culinary operations.

Elite Commercial Electrical Vehicles.—A new concern known as Elite Electric Vehicles, Ltd., has recently commenced the construction of electrical commercial motor vehicles at Tudor Lane, Cardiff. Lorries and vans of a carrying capacity of from 10 cwt. upwards are being turned out; while special attention is also being devoted to the construction of refuse-collection and street-watering machines.

Battery Manufacture in Sweden.—The Swedish Jungner Accumulator Co. reports a loss of 478,000 kronen for 1921, which is covered by appropriations from the reserve and contingency funds. This result compares with net profits of 232,000 kr. in 1920, and a dividend at the rate of 8 per cent. on the ordinary shares.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trade marks in respect of goods and productions associated with the electrical trades and industries. Firms desiring to enter an objection to any of the applications have one month in which to do so from the dates given below. In the case of foreign firms, the name of the representatives in this country to whom notice of objection should be sent is also given.

Watt (lettering and design). No. 422,218. Class 6. Dynamos, electric motors, blowers, &c. No. 422,088. Electrical goods in class 13. The "Watt" Electrical Co., Ltd., 17-18, Railway Approach, London Bridge, S.E. May 17th, 1922.

Condor. No. 418,842. Class 13. Electric lamps (ordinary). Naamlooze Vennootschap Popes Metaaldraad Lampenfabriek, Keltenstraat, Venloo, Holland. May 17th, 1922. (H. D. Fitzpatrick & Co., 94, Hope Street, Glasgow.)

Elwell-Parker, Loading, Electric Industrial Trucks. Four-wheel Steer (lettering and design). No. 421,683. Class 22. Electric trucks. The Elwell-Parker Electric Co., 4223, St. Clair Avenue, Cleveland, O., U.S.A. May 17th, 1922. (Gillespie Partners, Ltd., 80, Gracechurch Street, London, E.C.)

German Electrical Enterprise in Austria.—According to a dispatch from the *Times'* correspondent in Vienna, the Cabinet recently accepted the offer of the Allgemeine Electrizitats Gesellschaft of Berlin to take over the Wöllersdorf Munition Works. These works were enlarged during the war and used to employ over 30,000 hands. An attempt has been made to have them used for other purposes. Up to date they have been costing £25,000 a month, and something will certainly have to be spent on them for several years more before they can be made to pay. Under the agreement with the A.E.G. 60 per cent. of the capital in the company is to be Austrian, the Government itself becoming a prominent shareholder. It is proposed to convert the works for the manufacture of electric plant, boilers, and sewing machines.

South African Railway Electrification.—The *Morning Post* correspondent at Cape Town reports a speech delivered by General Smuts, in the Assembly, dealing with the country's industrial policy. He foreshadowed a new policy of bounties for Union iron and steel, extending to a period of ten years, and also a preference for South African copper in connection with the new electrification schemes.

For Sale.—Messrs. Paton & Baldwins, Ltd., of Rutland Mills, Wakefield, invite offers for one 400-kW turbo-alternator set.

Oldham Corporation Electricity Department has for disposal one Babcock & Wilcox land-type boiler, with chain grate stoker, economiser and induced draught plant, and one 1,200-kW mixed pressure Brush d.c. turbo-tandem generator with condensing plant. (See our advertisement pages to-day.)

Electrical Wages in Scotland.—We are officially informed that it has now been agreed between the Electrical Contractors' Association of Scotland and the Electrical Trades Union, in view of the reductions in wages which have taken place since the beginning of the year, that the present rate of pay should be stabilised until December 31st next, when it will be open to either party to review the situation. A correspondent states that the Association offered a stabilised minimum of 1s. 7½d. an hour for 1922, subject to no stoppage of work and the optional payment of a lower rate on shipbuilding work.

The Perth members of the Electrical Power Engineers' Association have applied to the Corporation for increased holidays, but the Electricity Committee have agreed to continue the present holidays pending the decision of the Scottish Council of the Industry.

The Aberdeen local branch of the Electrical Trades Union have asked the Corporation Electricity Committee to stabilise the present rates of pay to employés in the electricity works and lighting department as from the 1st inst. to May 1st next year. They point out there has been a reduction of 17s. already from July last year.

New Metropolitan-Vickers Showroom.—The Metropolitan-Vickers Electrcial Co., Ltd., added another showroom to its organisation on May 24th, when premises were opened at 127, George Street, Edinburgh. Everything in the way of lighting and small power appliances is on view, and special attention is being given to electric cooking and heating.

Copper and Lead Prices.—Messrs. F. Smith & Co. report May 24th:—Copper (electrolytic) bars, £70 10s., 45s. increase; do. do. sheets, no change; do. do. wire rods, £80 10s., 45s. increase; do. do. h.c. wire, 10¾d., 5/16d. increase.

Messrs. James & Shakespeare report May 24th:—Copper bars (best selected), sheet and rod, no change; English pig lead, £26 5s., 20s. increase.

Book Notices.—"The Directly-Useful (D.U.) Technical Series." London: Chapman & Hall, Ltd.—Two of the works in this aptly-named series have been re-issued. Part 1 of "Mathematics for Engineers," by W. N. Rose, B.Sc.(Eng.) (514 pp., price 10s. 6d. net) has reached its third edition, with a section on determinants added. A fourth edition appears of "Electrical Engineering Testing," by G. D. Aspinall Parr, M.Sc., &c. (691 pp., price 16s. net). The new edition has been considerably revised and enlarged, there being 132 additional pages, of which 116 relate to new a.c. and d.c. tests. A new volume has been added to the series—the first part of Messrs. Batson and Hyde's treatise on "Mechanical Testing" (413 pp., price 21s. net). This first volume deals with the testing of constructional materials. The scope of the work is so wide that it would be impossible to give it adequate treatment in the space available. The materials dealt with include steel, cast-iron, timber, stone, brick, concrete, limes and cements. Particulars of hardness and abrasion tests are given, and notes are made upon the effects of temperature, time, and shape. Measuring instruments and other apparatus receive careful consideration. The construction and employment of electric furnaces made at the N.P.L. are described, together with notes on pyrometric methods.

"Annual Report of the Smithsonian Institution, 1919." (557 pp., 134 plates). Washington (U.S.A.): Government Printing Office.—A number of interesting papers are included in this report, as well as financial particulars. An excellent review of the existing state of wireless telephony as applied to various purposes is included. A paper on "Radium and

the Electron," by Sir Ernest Rutherford, is reprinted from *Nature*, and a short description of the work of Sir William Ramsay, by Mr. Charles Moureu, appears.

Scientific Papers of the U.S. Bureau of Standards, No. 430, "High-Frequency Resistance of Inductance Coils"; and No. 431, "The Field Radiated from Two Horizontal Coils." Washington: Government Printing Office. Price 5 cents each.—In both papers the subjects are treated mathematically. In the first publication a formula is derived for the value of the current at any point in an inductance coil when the e.m.f. induced in any part of the coil is known. The latter paper deals with the characteristics of special transmitting coil antennæ designed to facilitate the landing of aeroplanes.

"Questions and Solutions in Magnetism and Electricity," by William J. White. 2nd edition (108 p.p.). London: S. Rentell & Co., Ltd. Price 2s. 6d. net.—The object of this work, as stated in the preface, is to aid students desirous of obtaining the certificate in magnetism and electricity awarded by the City and Guilds of London Institute. The questions set during the 1914-1918 period have been included in the second edition.

"Patents and Chemical Research," by Harold E. Potts, M.Sc. (198 pp.). Liverpool: The University Press. Price 8s. 6d. net.—This volume, although its title would appear to restrict its application, is mainly a treatise upon Patent Law, patent procedure, the preparation of specifications, &c., although the majority of the actual and hypothetical cases employed are of a chemical nature. The chapter on "Maximum Protection for an Invention" applies particularly to chemical inventions, and will be of considerable value to chemists in their search for information as to the "patentability" of processes and improvements. The final chapter deals with the state of the law in other countries; the United States of America receives considerable attention. At the end of the book is an index to the subject matter, and another of the actual cases cited in the work.

The Marconi International Directory, Buyers' and Exporters' Guide. London: Marconi International Code Co., Ltd. Price 25s.—This is the first annual edition of a large international business book of between 1,100 and 1,200 pages, which is so arranged as to enable the user to make quick reference to any item. The alphabetical section gives the full titles, description of business, full postal and cable addresses of the leading business houses of the world, and it is arranged in one complete series instead of providing separate lists for each country or State. Similarly, the Buyers' and Exporters' Guide shows under each trade heading the principal firms in each country engaged in that particular trade, and at one opening firms in any part of the world may be selected. There are indexes to the Buyers' and Exporters' Guide which have been translated into five different languages, thus enabling subscribers of almost any nationality to use the section. Another section is the cable address register, which enables one to identify the sender of a cablegram when an unfamiliar signature has been used. The volume should be very useful to those whose business calls for the dispatch and receipt of cables, or who buy or sell in foreign and Colonial markets.

"Boiler Plant Testing," by D. Brownlie. Pp. 12+168, 20 figs. Price 10s. 6d. net; "Principles of Electrical Engineering," by W. H. Timbie and V. Bush. Pp. viii+513. Price 20s. net. London: Chapman & Hall.

"Metropolitan-Vickers Gazette," Vol. IV, No. 109. April, 1922. Manchester: Metropolitan-Vickers Electrical Co., Ltd. Price 1s.

"Elementary Determinants for Electrical Engineers," by H. P. Few. Pp. 98; figs. 32. London: S. Rentell & Co., Ltd. 4s. net.

Dutch Wire and Cable Works.—The report of the directors of the N. V. Hollandsche Draad en Kabelfabriek of Amsterdam states that the year 1921 was one of falling sale prices under the influence of German competition. This decline, which was only partly equalised by the decrease in the cost of raw materials, was principally dominated by the sudden great fall in the mark, so that sale prices sometimes were below the purchase prices of raw materials. As, however, Germany also had to import raw materials which the company likewise needed for manufactures, such price proportions were only provisional, and again disappeared as soon as some stability in the exchange took place. It was not necessary for the company to follow such extremes, although orders had to be accepted at prices which only covered the direct expenses. According to quantity, the turnover in 1921 was 20 per cent. larger than in the previous year, but the profit balance was about one-third of that in 1920. In fact, the net profits amounted to 173,000 florins, as against 479,000 florins, exclusive of the balance forward, the former amount being devoted to depreciation and reserve funds. In 1920 a dividend at the rate of 8 per cent. was paid.

Ideal Home Exhibition, 1923.—We are informed that the Ideal Home Exhibition (*Daily Mail*) will be held again in March, 1923, instead of waiting until 1924. Electrical manufacturers should see to it that their applications for space are lodged at an early date. The Organising Secretary's address is 130, Fleet Street, E.C.4.

LIGHTING AND POWER NOTES.

Aberdeen.—Extensions.—The electricity works are to be extended at an estimated cost of £11,000.

Accrington.—Extension of Area of Supply.—The Corporation is applying to the Electricity Commissioners for authority to extend the area of supply of electricity so as to include the urban district of Oswaldtwistle.

Australia.—Sydney.—The City Council is to spend over £500,000 on additions to the electricity undertaking to meet demands for electricity up to the end of 1925. After that date it is proposed to erect a new power station at an initial outlay of £1,000,000.—*Reuter's Trade Service.*

Barrow.—Year's Working.—The annual report of the electrical engineer for the past year shows a total revenue of £77,122. Working expenses amounted to £51,010, as compared with £68,663, leaving a gross profit of £26,112. After providing for sinking fund and interest charges there was a net profit of £374. In the previous year there was a deficit of £2,500.

Ceylon.—Kandy.—The Municipality has arranged to purchase the electricity undertaking of the Colombo Gas and Water Works Co., at a cost of Rs.150,000.

Continental.—France.—The Société des Forces Motrices de la Loue has made application for a concession to set up a distribution network to serve 76 communes in the Département des Doubs and 44 communes in the Département du Jura.

The Compagnie Centrale d'Eclairage et de Chauffage par le Gaz (22, Rue de Londres, Paris) has applied for a concession to distribute electrical energy for public services in the Départements of Côtes-du-Nord and Ile-et-Vilaine, embracing 49 communes.

Germany.—Recent official statistics show that the output of public electricity supply stations in Germany rose from 2,200 million kWh in 1911 to 7,200 million kWh in 1920. The aggregate maximum demand was from 1¼ to 2 million kW in 1920. In that year there were eleven undertakings which supplied more than 100 million kWh, principal among which was the Rheinische Westfalisches Elektricitatswerke, which had an output of 626 millions, from a plant of 330,000-kW capacity. The difficulty of coal supply has had the effect of limiting further developments in generation by steam plant, and more and more attention is being paid to hydro-electric sources, such as the Middle and Lower Isar, the Walchensee, the Rhine-Main-Danube waterway and others to which we have made reference in previous issues. Schemes in hand aim at the development of some 200,000 kW—representing an annual output of 1,000 million kWh—and the harnessing of many other large water-powers is contemplated.

Crewe.—Price Reduction.—The charges for electricity are to be reduced by 12½ per cent.

Ealing.—Price Reduction.—The Borough Council is reducing the charges for electricity from 9½d. to 9d. per unit for lighting and by ½d. per unit for power supply.

Grays.—Electricity Supply.—At a recent meeting of the Urban Council the Electricity Committee reported that the Electricity Commissioners had declined to grant the loan of £5,500 for extensions to the electricity works, and suggested that the Council should wait until it could obtain electricity from the Barking station of the County of London Supply Co. The committee recommended that the urgency of the local situation be explained to the Commissioners, with a view to obtaining a reversal of this decision. The recommendation was adopted.

Haslingden.—Year's Working.—There was a profit of £513 on the working of the electricity undertaking for the past year.

Huddersfield.—Year's Working.—The annual report on the electricity undertaking for the past year shows a gross profit of £40,026. Loan charges, interest, &c., absorbed £39,613, leaving a net profit of £413.

Inverurie.—Electricity Supply.—Mr. J. C. Sawyers, consulting engineer to the Town Council, has submited a report on the proposed scheme of electricity supply to the town, in which he recommends that the Council approach the Scotland Railway Co. to ascertain the terms on which it would be prepared to lay mains, &c., or if the Council decides to install the mains, the terms on which the company would be prepared to give a supply of electricity.

Lyme Regis.—Electricity Supply.—The Electricity Commissioners are to hold an inquiry at the Town Hall on May 30th into the proposed scheme of electricity supply.

New Zealand.—Dunedin.—The City Council has decided to purchase a new 3,000-kW generator, which will be installed at Waipori. An agreement has been concluded with the Minister of Public Works under which the whole of its electricity will be purchased from the Government when the power from Arapuni is available, and the Council has guaranteed to pay £105,000 per annum for 15,000 kW. The Government has undertaken to commence work at Arapuni forthwith and to deliver electricity in bulk to the Power Board by April 1st, 1928.—*Reuter's Trade Service* (Wellington).

Polmont (Stirlingshire).—Electricity Supply.—There is a proposal before the County Council for lighting the district with electricity. The Scottish Midlands Electricity Supply, Ltd., has been asked to furnish estimates.

Portsmouth.—Price Reduction.—The Town Council has decided to reduce the charge for electricity to ordinary consumers by ¼d. per unit.

Preston.—New Power Station.—The Electricity Committee is making application to the Electricity Commissioners for consent to the establishment of a generating station, and to the borrowing of £416,450 for the purpose. The Town Clerk of Preston has been authorised to take the necessary steps, in conjunction with the Blackburn authority, for the presentation of a scheme for the Mid-Lancashire electricity district to the Commissioners at a local inquiry. The Commissioners have given formal consent to the Corporation's erecting a generating station at Penwortham, having an initial capacity of 20,000 kW.

Rickmansworth and Chorleywood.—Proposed Increased Charges.—The Colne Valley Electric Supply Co., Ltd., has applied for power to increase the charge for electricity to 10d. per unit, with minimum payments of 12s. 6d. for the winter quarters and 8s. 4d. for the summer quarters.

Shoreham.—Order Approved.—The Special Order made by the Electricity Commissioners in respect of the Urban District Council has been passed by the House of Lords.

Shrewsbury.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £13,500 for extensions to the electricity works, and will be prepared to give sanction to a further amount when the cost of carrying out the extensions has been ascertained.

St. Mellons.—Order Approved.—The House of Lords has approved the Special Order made by the Electricity Commissioners in respect of various parishes in the rural district.

Stirling.—Reduced Charges.—The Corporation has reduced the charges for electricity from 8d. to 7d. per unit for lighting, and has taken 32½ per cent. off the war increase for power.

TRAMWAY AND RAILWAY NOTES.

Blackburn.—Year's Working.—The annual report of the general manager of the tramway department (Mr. J. H. Cowell) for the year ending March 25th last shows a total income of £125,765, as compared with £137,759 in the previous year. Working expenses amounted to £107,460 (£119,841), leaving a gross profit of £18,305 (£17,918). Capital charges, interest, &c., absorbed £16,659, leaving a net profit of £1,646. There was a profit of £751 in the year 1920-21.

Bradford.—Railless Vehicles.—The text was recently issued of the Bill to confirm Provisional Orders of the Ministry of Transport for the alteration of Bradford local Acts authorising the Corporation to run railless trolley cars on a number of the routes at present served by tramways and on other routes. The Bill authorises borrowings for various other Corporation undertakings, and £10,000 for the purpose of a repair depôt, for the establishment and equipment of the trolley vehicles, and for tramway purposes, and such sums as the Minister of Transport may from time to time sanction. The Minister of Transport is given power to hold an inquiry with reference to the purposes of the Order.

Burton-on-Trent.—Year's Working.—The annual report of the Tramways Committee for the past year shows a loss on the year's working of £549, against a loss of £3,003 in the previous year. The number of passengers carried was over 4,000,000, and the cost per car mile dropped from 22.19d. to 21.49d.

Chile.—Railway Electrification.—The electrification of the Chilean State Railways is being carried out on a 3,000-V d.c. overhead system, on American principles. It is proposed to erect a 30,000-kW hydro-electric station for this and other purposes at Maitines. The power (50 cycle, three-phase) will be transmitted at 110,000 V to Santiago, a distance of 377 miles. There will be five sub-stations, each containing, in the first place, two 2,000-kW motor-generator sets. The locomotives will include six express passenger, 11 local passenger, 15 goods, and the shunting locomotives. These, and the rest of the electrical equipment, are being supplied by the Westinghouse Electric International Co.

Continental.—Italy.—The construction of two new railway lines in the province of Reggio Emilia will shortly be begun. The lines run from Reggio to Brescello and Novellare to Mirandola. For the former a guarantee of 600,000 lire in State securities has already been deposited, while a loan for the construction works has been arranged.

Dutch East Indies.—Railway Electrification.—After close study of conditions extending over several years, the Dutch East India authorities have decided to electrify the whole railway system. Direct current at 1,500 volts is to be used, but later the Batavia-Sourabaya section may be raised to 3,000 volts, single-phase, if conditions warrant.

Two power stations, giving about 40,000 horse-power, are being erected, one to the south-west of Sukabumi on the Tjitjatih, about 63 miles from Batavia, and the other on the Tji Anten, about 44 miles from Batavia. It is estimated that of this 40,000 horse-power, 30,000 will be required for the line and that 10,000 will be available for light and power in other directions. It is expected that the first part of the line, between Meester Cornelis and Tandjong Priok, will be in operation early next year. Tandjong Priok is sharing to a large extent in the awakening of activity observable in the Far East, and the electrification of its rail service should assist its development and add to its importance. A project is under consideration to erect a tin-smelting works at this port, and British experts have been consulted.

Haslingden.—Year's Working.—There was a loss of £320 on the tramway undertaking for the past year.

Iceland.—Railway Electrification.—It is reported that Norwegian engineers are now engaged on the construction of the first electric railway in Iceland, namely, between Reykjavik and Rangjavellir, a distance of 62 miles. The source of power is a waterfall on the Sog, where a generating station is being erected.

Leeds.—Express Cars.—The new express tramway track between Harehills Lane and Oakwood, Roundhay, was inspected on Friday last week by a representative of the Ministry of Transport, who expressed satisfaction with the work, and sanctioned the opening of the line, subject to certain minor precautions. After the inspection, Mr. J. B. Hamilton, tramway and commercial manager to the Corporation, announced that the connecting of the new and existing lines would be effected that night, and the first car would run on Sunday morning.

Manchester.—Threatened Strike.—A strike is threatened by the tramway track repairers over a cut in wages, the outcome of an arbitration award. The award reduces the wages of the day workers by 1½d. per hour and increases their hours by 5½ a week. The wages of the night workers are reduced by 7d. an hour. It is hoped to remove the discontent through the men's unions, which have arranged a conference with the Corporation.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Wireless Telegraphy.—Under the agreement signed by the Federal Government and the Amalgamated Wireless Co. for giving effect to a scheme for direct wireless communication with Great Britain, directors have been appointed by both contracting parties. Mr. Fisk, the company's manager, has sailed for England to arrange for the erection of a high-power station, says *The Times*.

Cable Rates.—Canada.—The Commercial Cable Co. announces that on and after May 22nd the charge for deferred messages between Great Britain and Cape Breton, Nova Scotia, New Brunswick, Prince Edward Island, and the Provinces of Quebec and Ontario was reduced to 4½d. per word. The Western Union Telegraph Co. makes a similar announcement.

Italy.—The surtax on telegraph and wireless telegraph communication rates with foreign countries paid for in Italian paper money was reduced to 300 per cent. as from the 10th inst.

France.—The rates for telegrams from France to places abroad were increased from May 16th.—*Reuter's Trade Service.*

Norway.—From May 1st telegraph rates were reduced 20 per cent. with all countries, except Sweden and Denmark.

England.—The rates for telegrams to many places abroad (a long list of which was published in the *London Gazette* of May 16th) from this country have also been revised.

Guernsey.—Telephone Extensions.—On May 10th a new switchboard was inaugurated at Telephone House in the St. Sampson's district of the island. Jurat J. E. Dorey, president of the States Telephone Council, explained that from the original expected maximum of 300 connections, it was expected to reach 3,000 by the end of the season. In 1898 the staff numbered 26; to-day it was 70. Mr. E. H. Bennett, manager of the States Telephone Department, said that the new board was designed to the specifications of Mr. A. R. Bennett, consultant to the department, and was supplied by the Federal Telegraph and Telephone Co., of America; Messrs. Pettigrew and Merriman, Ltd., being the European agents who supplied the main frame and power board. The switchboard was of the multipole type, and the calling indicators were self-restoring; the present capacity of the board was for 500 subscribers' lines, but it could be extended to accommodate 800. The subscriber called the exchange by magneto on Mr. A. R. Bennett's ring-through and clearing system. The ring-offs, operators' speaking, day and night bells, and fuse alarms were worked by a central battery. The cost of the equipment was £2,550, and that of the building £437. There was a total of 2,816 telephone stations on the island, or one telephone per 13.2 people. In 1899 the revenue was £1,047, while that in 1922 was £12,000. New underground cables were on order for the St. Sampson's district.—*Guernsey Evening Press.*

Italy.—New Telephone Lines.—An extraordinary outlay of 150,000,000 lire has been authorised by the Italian Government for the construction of new telegraph and telephone lines along the courses of the railways to be electrified. The above sum is spread over four years up to 1925.

Submarine Cables.—A convention has been concluded between the Italian Government and the Compania Italiana dei Cavi Telgrafi Sottomarine (Italian Submarine Cable Co.) for the laying, use, and maintenance of a cable between Italy and South America and of another between Italy and Greece. The former, says the *Financier*, is to connect Italy with Spain, Brazil, Uruguay, Argentina and—depending upon the consent of the respective Governments—with the Canary and Cape Verde Islands. The company engages to obtain from the interested foreign Governments the necessary permits for the cable approaches and for the working of offices at cable ends.

For the duration of this convention, which is fixed at 50 years, the Italian Government has agreed not to grant to another person or company the right to bring submarine cables to Italy for direct connection with South America, and also not to do this on its own account without first notifying the company which, on an equality of conditions, will always be given preference in matters of this kind over offers from other Italian or foreign companies.

The completion of the cable to South America must be effected within three years from the date of approval of the convention. Delay is subject to penalty, and a three-year delay will cause the convention to be annulled. The cable between Italy and Greece (from Brindisi to the Bay of Butrinto) is to be completed within two years.

Police Wireless.—*The Times* announces that for the last three months experiments have been going on at Scotland Yard to test the use of wireless as an aid to directing the movements of the police in search of criminals, and, according to the *Daily Mail*, a discussion on the subject will take place at the annual meeting of the Chief Constables' Association in London on June 2nd. In France and America experiments have been going on for some time, apparatus having been installed at various police stations and also on motor vehicles, which act as mobile receiving stations. According to *The Times*, every Chicago policeman is to be equipped with a miniature receiving set. The earlier pattern of apparatus, which was intended to enable constables to receive spoken messages, proved unsuccessful owing to interference from various causes. The pattern now in use simply reacts to wireless waves in such a manner as to produce a mild electric shock in the policeman's arm. He then hurries to one of the special police telephone boxes, which are placed on lamp-posts in all American cities, and calls up his station. Wireless receiving sets have been ordered for each of the fifty police stations of Chicago.

Sweden.—New Telephone Cable.—The Telegraph Board has informed the Government that it intends to lay a telephone cable between Sweden and Finland. As the cable will be imported, the Board requests that no Customs duties be imposed. —*Reuter's Trade Service* (Stockholm).

Wireless Telephony.—New Claim.—It is claimed for Mr. John Hays Hammond, junior, that he has perfected a comparatively simple apparatus to prevent any radio station from receiving messages except those which are intended for it. The same wave can be made to carry several messages at the same time, and, further, it is stated that both voice and code may be transmitted.—*Daily Telegraph*.

Broadcasting.—According to the *Daily Express*, the Postmaster-General has addressed a letter to the hon. secretary of the Wireless Society of London, in which he states that he has considered the recommendations of the committee of the Society regarding regulations governing amateur transmission. He agrees that the restriction that transmission must be confined to five other stations should be withdrawn, and that transmission should be permitted for an aggregate maximum of two hours in each twenty-four hours, with certain reservations. The following wave lengths will be allocated for amateur transmission:—150 to 200 metres, inclusive (spark c.w. and telephony) and 440 metres (c.w. and telephony only). The fixed wave-length of 1,000 metres will be withdrawn.

The Times records that on May 18th a private meeting of representatives of firms engaged in the manufacture of wireless apparatus was held at the General Post Office to discuss the arrangements to be made to carry into effect the scheme recently announced by the Postmaster-General in the House of Commons for broadcasting matter (including music) by wireless sets.

"It was recognised generally that, in order to avoid interference, broadcasting stations would have to be very limited in number. Some of the representatives thought that not more than eight could work simultaneously in Great Britain, using the power (1½ kilowatts) and the band of wave-lengths (350-425 metres) allowed for the purpose, without such interference as would produce practical chaos. The best means of attaining the objects seemed to lie in co-operation among the firms concerned, and it was suggested that one or possibly two groups should be formed, which should become responsible, both financially and otherwise, for the erection and maintenance of the stations and the provision of suitable programmes. It was arranged that the various firms should collaborate in the immediate preparation of a co-operative scheme, or at the most of two such schemes, for consideration by the Post Office authorities."

A private conference of manufacturers of wireless apparatus was held at the Institution of Electrical Engineers on May 4th, at which Mr. Godfrey Isaacs presided, with the object of arranging a scheme of co-operation; 23 firms have signified their readiness to broadcast, but that figure is thought to be too large. At present only two broadcasting stations, one in London and the other at Manchester, are fully equipped.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Argentina.—Buenos Aires.—June 28th. Argentine Board of Sanitary Works. Hydro-electric generating station and transforming sub-station for the town of Catamarca:—Three 165-h.p. Pelton wheels, three 110-kW three-phase alternators, switchboard, two 20-kVA three-phase static transformers, piping, valves, and accessories, spares, &c.; two 130-kW motor-generators, with switchboard and spares.*

Buenos Aires Waterworks.—Machinery for three pumping stations, one power station, and eight transforming sub-stations. Copy of the specifications and conditions of tender (in Spanish), with blue prints, can be seen at the Department of Overseas Trade, 35, Old Queen Street, E.C. (Room 49), up to June 10th.*

Australia.—Melbourne.—September 1st. Electricity Commission. Five surface feed-water heaters, six surface vapour condensers, 12 feed-water evaporators. (May 19th.)

October 17th. Postmaster-General's Department. Supply of automatic switchboards and associated apparatus for two suburban exchanges at Melbourne.

June 20th. Postmaster-General's Department. 420½ tons bronze wire (sched. 28), 400 tons galvanised iron wire (sched. 32), 47 tons galvanised steel wire (sched. 32), 413,400 jointing sleeves (sched. 33). (May 19th.)

June 7th. Victorian Railways. Supply and delivery of 7,190 steel rails (60 lb.); 7,390 fishplates.*

June 17th. Aluminium steel-cored cable and accessories. (Spec. No. 243.) (See this issue.)

Queensland (Bowen).—June 30th. Municipal Council. Electric power generating plant, switchboard and other equipment.

Barnes.—June 5th. Electricity Department. 3,500 yd. l.p. cable, .40 × .40 × .20 sq. in.; a portion lead-covered and drawn into existing ducts, and a portion armoured and laid direct. (See this issue.)

Bulgaria.—Sofia.—June 15th. Post and Telegraph Department. Fuses, line annunciators, and lightning arresters.*

Glasgow.—June 2nd. Electricity Department. Works in connection with the erection of a sub-station at Greenhead Street, East Bridgeton. Electrical engineer, 75, Waterloo Street.

India.—June 9th. High Commissioner's Department. Copper telegraph wire. Carsack elements for Leclanché cells, v.i.r. insulated cable. (May 19th.)

Italy.—July 31st. The State Railways announce that the period for the reception of tenders for the electrification of the Bologna-Venice-Monfalcone line, fixed previously for April 30th, 1922, has been extended until July 31st, 1922.

Kirkcaldy.—June 5th. Electricity works. Steam turbine, three-phase alternator, condensing plant and piping. (May 12th.)

London.—Islington.—May 27th. Board of Guardians. Electric light and power installation at the Institution, &c., St. John's Road, Holloway. (May 19th.)

Metropolitan Asylums Board.—June 21st. Installation of forced circulation heating and hot-water supply apparatus, domestic cold-water supply and fire hydrant service, gas supply mains, &c. Installation of electric lighting and power, telephones, fire alarms, and domestic bells. (See this issue.)

Hackney.—Electricity Department. New or second-hand, for battery charging purposes: D.c. generator, only belt driving, 150/200 amp., 50 V., or, alternatively, combined motor generator set, above capacity, for use on 480-V d.c. circuit. (See this issue.)

Maidstone.—June 30th. Kent County Mental Hospital. Two 3-phase back-geared electric motors, two centrifugal pumps and accessories, main switchboard, starting and controlling gear and wiring. (See this issue.)

Manchester.—June 13th. Electricity Committee. Electrical distance indicating and recording thermometers, fans, auxiliary circulating water pumps, electric capstans and bollards. (See this issue.)

June 15th. Electricity Committee. Cable requirements for six months. Mr. F. E. Hughes, Electricity Department, Town Hall, Manchester.

New Zealand.—Wellington.—July 4th. Department of Public Works. Three 1,320-kVA single-phase transformers, with accessories.*

The Southland Electric Power Board invites tenders, closing in September, for electrical apparatus, including transformers, cables, switches, insulators, meters, and other equipment.—*Reuter's Trade Service* (Invercargill, N.Z.).

June 10th. City Council. One 25-ton overhead travelling crane, three 1,500-kW and one 500-kW rotary converters, with transformers. (See this issue.)

Nottingham.—June 9th. Electricity Department. North Wilford power station. Six steel-tube fuel economisers, four steel chimneys, six induced draught fans, &c.; e.h.p. main switchgear, e.h.p. and l.p. auxiliary switchgear, cable connections, &c.; three 30-in., one 10-in., and three 3-in. electrically-driven centrifugal pumps; one 75-ton overhead travelling electric crane, one 10-ton and one 5-ton overhead travelling hand crane, &c.; two 750-kW rotary converters, one 35-kW motor generator-booster, &c. (May 12th.)

Preston.—June 24th. Electricity Department. Boilers, stokers, economisers, fans, chimneys, feed piping, and feed pumps. (May 12th.)

Rhondda.—June 6th. Electricity Committee. Sub-station e.h.p. and l.p. switchgear. (May 19th.)

Salford.—June 15th. Electricity Department. Two 10,000/12,000-kW turbo-generator sets with condensing plant, auxiliaries and piping connections, house service plant comprising one 1,200-kW turbo-generator and two a.c. 6,000/220 V. d.c. motor generators, boilers, stokers, economisers, fans, chimneys, steam and feed piping and feed pumps. (See this issue.)

Siam.—Bangkok.—June 28th. Department of Posts and Telegraphs. Telegraph and telephone material, including wire, cable, wall telephones, &c.*

South Africa.—Frankfort, Orange Free State.—The Municipality is inviting tenders for a hydro-electric scheme. Particulars from the consulting engineer. Mr. W. Ingham, 101, Consolidated Buildings, Fox Street, Johannesburg.

Grahamstown, Cape Province.—September 1st. Power plant, alternators, switchboard, transformers, cables, &c. Specifications from Mr. F. G. Clarkson, town clerk.*

Sunderland.—June 1st. Tramways Department. 150 tons of steel tramway rails. General manager.

West Ham.—June 13th. Electricity Department. One 10,000-kW turbo-alternator, one 10,000-kW surface condensing plant. (See this issue.)

Warrington.—May 30th. Cheshire Lines Committee. Six months' supply of stores and materials, including telegraph materials. Stores Superintendent, Cheshire Lines, Warrington.

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*A copy of the plan, specifications, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Aberdeen.—Finance Committee. Recommended:—
Electric lighting work at the Fish Market (£274).—Petrie & Co.

Belgium.—Five firms—four Belgian and one German—submitted tenders recently to the Société Nationale der Chemins de Fer Vicinaux, of Brussels, for the supply and laying of the underground armoured cables and special returns in connection with the secondary electric railways in the North Antwerp section. The lowest offer (338,961 fr.)) was that of the Deutsche Kabelindustrie Gesellschaft, of Berlin.

Bideford.—The Electric Light Co. has accepted the tender of Messrs. Crompton & Co., Ltd., for the construction of the new works.

Government Contracts.—The following Government contracts were placed during April, 1922:—

Admiralty Contract and Purchase Department.

Motor generator with control gear, &c.—Crompton & Co., Ltd.
Insulating materials.—Mica Manufacturing Co., Ltd.; E. Macbean & Co., Ltd.; I. N. Hardy & Sons, Ltd.; Ioco Rubber & Waterproofing Co., Ltd.; Attwater & Sons; Micanite & Insulators, Ltd.; H. Clarke & Co. (Manchester), Ltd.
Switches and indicators.—Whipp & Bourne, Ltd.

Air Ministry.

Motor generator.—Crompton & Co., Ltd.

Post Office.

Telephone apparatus.—Western Electric Co., Ltd.
Testing, protective apparatus, &c.—British L.-M. Ericsson Manufacturing Co., Ltd.
Telegraph and telephone cable.—Enfield Ediswan Cable Works, Ltd.; Hackbridge Cable Co., Ltd.
Dry cells.—Ever-Ready Co. (Great Britain), Ltd.; Siemens Bros. & Co., Ltd.
Stationary secondary cells.—Oldham & Co., Ltd.; Van Raden & Co.
Lamp caps.—J. Hannan.
Mouthpieces for telephones.—North British Rubber Co., Ltd.; Siemens Bros. & Co., Ltd.
Lead sleeves.—Henley's Telegraph Works Co., Ltd.; Western Electric Co., Ltd.
Insulated staples.—Tower Manufacturing Co., Ltd.
Copper wire.—Enfield Ediswan Cable Works, Ltd.
Manufacture, supply, drawing-in, and jointing cable.—Brixton-Hop Junction: Western Electric Co., Ltd.
Telephone exchange equipment.—Nelson: Peel-Conner Telephone Works, Ltd.; sub-contractors for batteries, D. P. Battery Co., Ltd. Stock for various automatic exchanges in contemplation:—Eastbourne: Siemens Bros. & Co., Ltd.; sub-contractors for batteries, D. P. Battery Co., Ltd. For charging machine: English Electric Co., Ltd.

H.M. Office of Works.

Engineering services electric lifts.—Express Lift Co., Ltd.
Llantrissant houses, electric wiring.—Electra Contracting Co.

Crown Agents for the Colonies.

Carbons.—General Electric Co., Ltd.
Induction motors, &c.—Metropolitan-Vickers Electrical Co., Ltd.
Pole distribution boxes, &c.—British Insulated & Helsby Cables, Ltd.
Telegraph instruments.—India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.

War Office.—The Edison Swan Electric Co., Ltd., has secured from the War Office a contract for the supply of dry batteries.

Lodz.—Word has reached Bolton from Lodz that Messrs. Dobson & Barlow, Ltd., of Bolton, have received an order for 100,000 spindles and other textile machinery for a large spinning mill in that centre which is being rebuilt after a recent fire. The new factory will be electrically driven, and contracts for the necessary plant (which includes two steam turbines) have been placed with English firms. It is expected that the mill will be running at full capacity during the autumn.

London.—St. Pancras.—Electricity and Public Lighting Committee. Coal for King's Road station:—
500 tons 1½ in. Cadley Hill nutty slack, 20s. ton, delivered; 500 tons ¾ in. to ¾ in. Clifton peas, 18s. 10d. ton, delivered; 1,000 tons Pinxton hard nutty slack, 20s. 11d. ton.—J. H. Beattie & Co., Ltd. (recommended).

H.p. switchgear for Grafton Road sub-station and motor converting plant for Regent's Park sub-station:—

Park Royal Engineering Works	£3,000
British Thomson-Houston Co., Ltd. (recommended)	**3,044**
Metropolitan-Vickers Electrical Co., Ltd.	3,162
New Switchgear Construction Co., Ltd.	3,349
Switchgear & Cowans, Ltd.	3,467
Ferguson, Pailin, Ltd.	3,498
Electric Construction Co., Ltd.	3,786
Johnson & Phillips, Ltd.	4,097
Sprecher & Schuh Co.	4,307
English Electric Co., Ltd.	4,370
General Electric Co., Ltd.	4,850
Reyrolle & Co.	5,288
Mudie's Electric Co.	5,429

Ten l.p. d.c. switchboards, with white marble panels, complete with circuit-breakers, ammeters, bus-bars, &c. (£800).—Northcote, Heaye & Co. (recommended).
Electrically-driven 8-stage centrifugal pump (£915).—Holden & Brooke (recommended).

Hammersmith.—Electricity Committee. Recommended:—
Cable for Wormholt Housing Estate (£390).—Hackbridge Cable Co., Ltd.
Ordinary and prepayment meters for 12 months.—Ferranti, Ltd.

New Zealand.—The Government has accepted further tenders, aggregating £32,000, in connection with hydro-electric installations on the Waikato River, Auckland Province. The acceptances comprise tenders for head gates, turbines, generators, and exciters. All the tenders accepted were British, including one Canadian, although in some cases foreign tenders were the lowest.—*Reuter's Trade Service* (Wellington).

FORTHCOMING EVENTS.

Association of Engineers-in-Charge.—Saturday, May 27th. At the Holborn Restaurant (Venetian Chamber). At 6 for 6.30 p.m. Twenty-second annual dinner.

Electricity District Inquiry.—Tuesday, May 30th. At the Middlesex Guildhall, Westminster, S.W. At 10.30 a.m. Inquiry by the Electricity Commissioners into the applications of the South-Eastern & Chatham Railway Co.'s Managing Committee and the West Kent Electric Co., Ltd., for consent to the establishment of power stations at Charlton and Belvedere respectively.

Institution of Electrical Engineers (Scottish Centre).—Summer meeting, May 30th to June 2nd. At Glasgow. The following papers will be read:—Tuesday, May 30th. At the Royal Technical College. At 10 a.m. Paper on "The Dalmarnock Generating Station," by Mr. R. B. Mitchell. Wednesday, May 31st. At the University. At 10.15 a.m. Paper on "The Hydro-Electric Resources of the Scottish Highlands," by Prof. Magnus MacLean.

Junior Institution of Engineers.—Thursday, June 1st. At the Institution of Electrical Engineers, Victoria Embankment, W.C.2. At 7.30 p.m. Canet Lecture on "The Railway Act of 1921," by the Rt. Hon. Sir Eric Geddes.

Chemical Society.—Thursday, June 1st. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

To enable us to complete replies to queries received this week we need the names of suppliers or manufacturers of :—

The Fox universal voltage electric iron.

NOTES.

Lock-out Developments.—Since our leaderette pages went to press the negotiations between the Employers and the A.E.U. have once again come to a deadlock. The new proposals of the A.E.U. were unacceptable to the employers, who in turn submitted the proposals that had been accepted by the representatives of the 47 unions. The A.E.U., after consideration of the employers' statement, said that they were unable to say anything further on Wednesday. The employers said that they were quite willing to meet the A.E.U. again if they wished to make further proposals or to negotiate a settlement on the lines of the terms now being ballotted upon by the 47 unions.

With regard to the iniquitous and ludicrous proposal that union members employed in the maintenance of gas, water, sewage, and electric light and power undertakings in the County of London should be called upon to give seven days' notice so as to bring pressure to bear upon the engineering employers, this suggestion was turned down last week by the National Federation of Engineering and Shipbuilding Trades at Portsmouth. In view of this rejection the matter is now to be brought before the Executive of the A.E.U. We have expressed our opinion of this movement in our leaderette pages to-day. The A.E.U. and others interested would do well to nip the scheme in the bud. We predict that if they proceed far with it they will thereafter lose all along the line.

A Birmingham War Memorial.—A very beautiful memorial (a cenotaph) to the employés of the Birmingham Corporation Electric Tramways who gave their lives in the war, has been erected in the Tramway Stadium, at King's Heath. It will be dedicated by the Bishop of Birmingham on Sunday, May 28th, at 9 p.m., and unveiled by Lieut. Clarke of the Dorset Regiment. The Lord Mayor will give an address. The girls who acted as tramcar conductors during the war will lay a wreath on the cenotaph.

Accidents.—While an electrician named William Mawhinney was assisting to put up an electric lighting installation in one of the weaving sheds in the factory of Messrs. Dickson and Sons, Dungannon, Co. Tyrone, he was caught in the machine belting and his right arm was torn off at the elbow.

At the Burnley Electricity Works on May 17th, two men employed by the Stirling Boiler Co. were erecting a new boiler when steam was let off from another boiler. They were badly scalded and taken to the infirmary.

Late Legal.—In the Mayor's and City of London Court, on Tuesday, before Mr. Registrar Dell, a claim was made by the County of London Electric Supply Co., Ltd., Moorgate Court, Moorgate Place, against Mr. M. Goldberg, 3, Bayer Street, for £1 13s. 4d., the cost of repairing an electric meter. The plaintiffs' representative said that the company's meter was damaged by fire at the defendant's premises 12 months ago. They thought the defendant was going to contest the case, as he had stated that the plaintiff company did not claim early enough to enable him to place the matter before the fire insurance authorities. The Registrar said he was wondering how the defendant was made liable for the damage, but he saw from the agreement, produced that the defendant acknowledged that he was responsible for the meter. Plaintiffs' representative said that the defendant had written to the plaintiffs' solicitors saying, although he did not admit the claim, he would pay. There was no appearance on behalf of the defendant, and judgment was entered for the plaintiffs for the amount claimed with costs.

India as a Source of Lac, Turpentine and Resin.—Reports on Lac, Turpentine and Resin were recently issued by Messrs. John Murray, 50a, Albemarle Street, W. (price 5s. net), as a result of inquiries conducted by the Imperial Institute Committee for India into the possibility of further commercial use in the United Kingdom of these raw materials. The importance of preserving and enlarging Empire sources of raw materials is illustrated by the investigations of the Committee, which prove that lac, turpentine and resin are in increasing demand, and that steps to encourage better methods of production are watched with interest by manufacturers in this country. Among the firms which gave evidence before the Committee as to the industrial uses of the materials mentioned were W. T. Henley's Telegraph Works Co., Ltd., Edison Swan Electric Co., Ltd.; British Electrical Federation, Ltd.; Callender's Cable and Construction Co., Ltd.; Siemens Bros. & Co., Ltd.; Courtaulds, Ltd.; the Gramophone Co., Ltd.; Jenson & Nicholson, Ltd.; and R. Ingham Clark & Co., Ltd. The report in question will be read with interest by those who employ these materials in their business.—*Bulletin of the Federation of British Industries.*

Educational.—Technical Education in South Africa.—We have received a copy of a prospectus of technical evening classes and domestic science courses instituted by the School Board for the Cape Division. The classes are arranged, generally, in seven "years," ranging from elementary principles to an advanced stage. The subjects scheduled include electrical and mechanical engineering, and there are special courses in electro-technics, wireless telegraphy, &c. The Technical College, in Cape Town, to which these courses will be transferred, is nearing completion, and is expected to be opened before the end of the present year.

Electricity as a By-Product.—Few factories are so fortunately placed as the Crockett sugar refining works, California, which the *Journal of Electricity and Western Industry* says is reputed to be the largest in the world. A great amount of steam is required for the refining processes, and instead of generating this and passing it through pressure-reducing valves to bring it down to 10 lb. per sq. in. pressure, turbines take the place of the valves and produce electricity. The steam supply is sufficient to drive three 1,500-kW turbo-generators, which supply power to 700 motors, with an aggregate capacity of 10,000 h.p. These motors range from 1 to 350 h.p., but the general size is 15 h.p. The daily output of the factory is 2,000 tons, and storage capacity for 600,000 tons is provided, all handling being done electrically.

Fatalities.—Sheriff Shennan and a jury conducted an inquiry at Hamilton, on Saturday, into the deaths of two miners, as the result of injuries received in an explosion in No. 1 Pit in Viewpark Colliery, Uddingston, on April 11th. Evidence showed that the explosion occurred at an electrical coal cutter in the splint coal seam of the pit, and it was shown from the books of the colliery that gas had been found in this section previously. It was also stated that complaints with regard to this coal cutter had been made, and that the machine had been repaired by the colliery electrician, who stated that it was in good order prior to the explosion. After the explosion, the machine was found to be without certain studs and bolts, which, it was admitted, made the machine not flame-proof. The jury returned an open verdict.

The *Daily Mail* states that while playing in a field near the National Radiator Works, at Hull, on May 20th, Terrot Glover Butlin, 12, climbed an electric power standard and caught hold of the conductors, after which he fell to the ground. On admission to the Hull Royal Infirmary the boy was found to be dead.

At Dudley, on Monday, an inquest was held concerning the death of James Harold Johnson, aged 21, an electrical fitter's assistant, who died on the 18th inst. from the effects of injuries received on the 16th inst. while at work at the Midland Electric Corporation's works at Ocker Hill. Mr. A. L. Tackley, H.M. Divisional Electrical Inspector of Factories, and Mr. Wolffe, H.M. Inspector of Factories, were present. According to the medical evidence, the man died from shock, following very severe burns about the arms and the trunk. A. H. Hunston, an electrical fitter, employed by the company stated that he, Johnson, and a labourer were engaged in the transformer house, mounting a small transformer on the wall. Witness was holding it and Johnson was screwing it up. He had fixed the two bottom screws and had started on the third when witness heard a cracking noise and a flash, and on turning round saw Johnson on the floor with his clothing in flames. Witness said he did not have anything to do with the fixing of a copper bar near where the accident happened. It was quite possible that Johnson could have reached the rod from the box on which he was standing. Mr. Edward Ralphs, the station superintendent, said that he was inclined to the view, after having made an examination, that Johnson must have come into contact with the conductor. A piece of the wire was black and that indicated that it had been in contact with something that was not metal. The Coroner entered a verdict of "Accidental death."

Fuse Replacement by Consumers.—In the early days of electricity supply, when consumers were few, the companies found it helpful to keep a man or men for the purpose of replacing blown fuses. What was a minor expense then has become a considerable item of expenditure. Accordingly, a writer in the *Journal of Electricity and Western Industry* suggests that consumers should be educated to replace their own fuses by means of a few simple rules set out, with illustrations, on a card. This might certainly save a great deal of time and money if the simple task was properly learned by the consumer.

Appointments Vacant.—Chief engineer, for an electric tramway and supply undertaking in the East; lecturer in electrical science (£300), for the Holt Technical School; jointer (450 Rs. per month), for an electrical undertaking in Burmah; assistant generation engineer, 550 taels per month; station control engineer, 450 taels per month; and station electrical assistant, 350 taels per month. Shanghai Municipal Electricity Department. (Tael=3s.). (See our advertisement pages to-day.)

Small Private Generating Stations.—The Electricity Commissioners have decided not to make regulations as to the type of current, frequency, and pressure under Section II of the

Electricity (Supply) Act, 1919, in the case of private generating stations having an installed capacity not exceeding 50 kW. No notification need be made to the Commissioners regarding the establishment of such stations.

Wireless Wave Meters.—On May 15th the Royal Commission on Awards to Inventors heard a claim by Prof. J. S. E. Townsend, F.R.S., Professor of Physics at Oxford, in respect of an invention called a wave meter. At the time he made the invention he was an officer in the Royal Naval Volunteer Reserve, his duties being to instruct officers in the theory and practice of wireless telegraphy. The invention indicated the particular wave which an instrument was emitting when used as a transmitter, or the length of the wave which the instrument was receiving when operating as a receiver. Counsel went on to describe how the wave length was varied by altering either the capacity or the inductance. Prof. Townsend's wave meter varied the inductance. Counsel produced one of the meters, a small box somewhat resembling a camera in outward appearance. Prof. Townsend and Prof. Whiddington, of Leeds, gave evidence in support of the claim, the latter laying stress on the fact that the invention could be used for continuous wave work, and that it was extremely accurate. Mr. Trevor Watson, for the Crown, said that about 2,000 of the wave meters were in use towards the end of the war, and he admitted that the instrument was the best of its kind at that time. While it was highly practical and extremely accurate, he contended that most of the ideas embodied in the invention had been the basis of previous patents. The Commission reserved its decision.—*Manchester Guardian.*

Recovery of Hughes's Instruments.—In *Nature* of April 15th Mr. A. A. Campbell Swinton, F.R.S., gave an account of his discovery of a room in a furniture depository filled with Hughes's personal effects, which had been stored since his death in 1900:—

"The effects were carefully examined, when not only were there discovered eight more note-books—one containing an illustrated account of Hughes's invention of the microphone—but also numerous instruments.

"These comprise a number of microphones, of which several are different-sized instruments of the well-known pivoted-lever type. Others consist of pointed carbon pencils, loosely held at their ends between fixed carbon sockets, the whole being mounted on sounding-boards, which in one case takes the form of an inverted Japanese ash-tray. Several more consist of carbon pencils suspended pendulum-wise by paper strips, so as to bridge other carbon pencils mounted on vertical sounding-boards, while others, again, consist of glass tubes containing either carbon blocks held together by a light spiral spring, or carbon granules. Finally, among the microphones, there is the one consisting of three French nails that has served to illustrate many a text-book.

"In addition there is an induction balance, probably the first one that Hughes made, together with the actual instruments with which he practised wireless telegraphy in 1879. They are all readily identified from the illustrated descriptions in the note-books, and include the clockwork with which currents from a single-cell battery, connected to one of the coils of the induction balance, were interrupted so as to transmit wireless signals. There are also two Bell telephones, evidently made by Hughes himself together with two more which he says were made for him by Sax, which he used for wireless reception in connection with a water-tight pocket battery, and a special microphone that seems to have acted as a self-decohering coherer. This latter is contained in a glass bottle, the loose contact being made between a steel needle and a wire loop, which latter Hughes says he made more sensitive by coating it with soot from the flame of a spirit lamp.

"With these simple pieces of home-made apparatus Hughes not only prepared the way for the modern telephone transmitter, but also transmitted and received wireless signals over distances up to 300 yards no less than 43 years ago.

"All these instruments have been made over to the Science Museum, South Kensington, by Mrs. Hughes's trustees, and are now on view in Room No. 10."

INSTITUTION NOTES.

Institution of Electrical Engineers.—Election of Council. The result of the ballot for the election of officers and new members of Council for 1922-23 was as follows: President, Mr. F. Gill. Vice-presidents: Dr. W. H. Eccles, F.R.S., and Mr. A. A. Campbell Swinton, F.R.S. Honorary treasurer, Sir James Devonshire, K.B.E. Ordinary members of Council: Mr. J. W. Beauchamp, Mr. R. A. Chattock, Mr. F. W. Crawter, Mr. D. N. Dunlop, Major K. Edgcumbe, Mr. A. F. Harmer, and Mr. W. R. Rawlings.

Kelvin Lecture.—On Thursday last week Sir Ernest Rutherford delivered the Kelvin Lecture before an audience which filled the whole of the lecture theatre, standing room included, and which gave an enthusiastic reception to the speaker.

The lecture, which was entitled "Electricity and Matter," referred mainly to recent progress in the investigation of the structure of the positive nucleus of an atom, which appears to be highly complex; the most striking feature of the work was the disintegration of atoms by bombarding them with the alpha-particles emitted from radium, which, in fact, are the nuclei of helium, and, when expelled, represent the most highly-concentrated source of energy known to the physicist. Only about two in a million of these "projectiles" are successful in striking the target (a nucleus), but seeing that the latter is almost one-1,800th of the size of an electron, the failure to hit every time is excusable. The particles driven out of the atoms have a maximum range proportional to the range of the bombarding particles, are believed to be always atoms of hydrogen, no matter what their origin, and may have a greater maximum energy than that of the projectile, some of which, therefore, is derived from the disintegrated nucleus.

Professor E. W. Marchant moved, and Mr. S. Evershed seconded, a vote of thanks to the lecturer, which was accorded by acclamation.

The Faraday Medal.—The president, Mr. J. S. Highfield, announced at the last meeting of the Institution that a bronze medal had been struck to commemorate the fiftieth year of the Institution, and that the first award of the medal had been made to Mr. Oliver Heaviside, F.R.S., Hon. Member. Sir Oliver Lodge, at the invitation of the President, expressed his cordial appreciation of the proposed award, which was endorsed by the meeting with enthusiasm.

Irish Centre.—Under the joint auspices of the Royal Dublin Society and of the Irish Centre of the Institution of Electrical Engineers, Mr. Borlase Matthews, M.I.E.E., delivered a lecture in the theatre of the Royal Dublin Society, on the subject of "Electro-farming or the Application of Electricity to Farming." Lord Rathconnell, president, Royal Dublin Society, occupied the chair. Mr. Matthews said that, in his opinion, which was based upon experimental work conducted on a commercial scale, the highest efficiency in farming could be reached only by electrical methods. The conclusion that he had arrived at was that in future, for the most successful operation of farms, the use of electricity would be essential from the points of view both of cutting down the total cost of power and labour, and of obtaining an increased output. The lecture was illustrated with lantern and kinematograph slides, showing the application of electrical energy to the different operations in farming.

Results of April Examination.—The results of the April examination of candidates for associate membership have been published. Thirty-six passed the whole examination; sixteen passed Part II only; and two passed Part I. The examination of officers of the R.E. and Royal Corps of Signals resulted as follows:—Passed whole examination, seventeen; passed Part I only, one.

Glasgow and District Radio Club.—At a recent meeting Mr. A. F. Stevenson lectured on "Cable Engineering," and described how various types of cable were manufactured. Lectures on "Capacity and Inductance" were recently given by Mr. M. McLennan, and these included full directions for making receiving sets. The club has secured new premises at 20, Buchanan Street, which will be put into use in October.

Junior Institution of Engineers.—The fourth quadrennial Gustave Canet lecture, entitled "The Railway Act, 1921," will be given before the Junior Institution of Engineers by the Right Hon. Sir Eric C. Geddes, G.C.B., G.B.E., on June 1st, in the lecture theatre of the Institution of Electrical Engineers. The chair will be taken at 7.30 p.m. by Mr. C. H. Wordingham, C.B.E., President of the Institution. Tickets may be obtained from the Secretary, 39, Victoria Street, S.W.1. The Gustave Canet Lecture commemorates the presidency of the Institution of the late M. Gustave Canet, the eminent French artillerist, during a period immediately preceding his death in 1908.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Sir Ernest Rutherford, who delivered the Kelvin Lecture before the I.E.E. last week, has so long been an outstanding figure among British—and other—physicists that it may surprise many, who do not know him, to learn that he is to-day only fifty years old. Born in 1871, in Nelson, New Zealand, he started his career by collecting all such honours in physics as were available in his native land. He came to England in 1895, and started in the Cavendish Laboratory, at Cambridge, under Sir J. J. Thomson, where he had as fellow students a band of men who have, almost without exception, done brilliantly in physics and achieved high positions in the academic world. His first work was on electric waves, and he invented incidentally the detector, based on the demagnetising of thin wires by electrical oscillations, which bears his name. He also carried out investigations on the velocity of ions in gases, and when, in 1898, he was appointed Professor of Physics at McGill University, Montreal, he was already interested in the subject with which his name is inseparably connected, radio-

activity. The fact that he was appointed to a professorship in an important university at the age of twenty-seven, is indicative of one of his chief characteristics, a marked disinclination to waste time. He started his radioactive career by an extensive series of investigations into the radiations from uranium, following which he discovered most of the chief properties of radioactive substances—he demonstrated the existence and nature of the emanations and of the radioactive deposits, and clearly separated the radiations into the three types still known as α, β, and γ rays, proving by the use of very strong magnetic fields that the α-rays are positively charged particles, which he later showed to be helium atoms. The study of the properties of thorium and its product thorium X, and of the analogous properties of uranium, led him to enunciate with Prof. Soddy, in 1902, the theory of radioactive decay—or atomic disintegration—which has ever since remained the basis of all study of radioactive change, and proved completely successful in accounting for the growth and decay of all radioactive substances. So firmly established is the theory that it is hard to go back mentally to the time when atoms were considered indivisible and indestructible, and to realise to the full the novelty of the conception twenty years ago of the unstable atom, radiating energy.

In 1903, Rutherford was elected a Fellow of the Royal Society, at the age of 32, and in the same year delivered a course of the celebrated Silliman lectures. Four years later

Russell, [*London.*

SIR ERNEST RUTHERFORD.

a new period in his career was initiated by his appointment as Langworthy Professor of Physics, at the University of Manchester. Here for the first time he had about him a band of enthusiastic research students from many countries, whose collaboration enabled him to make even fuller use of his powers. It is impossible to mention more than a few among even the more important investigations of the Manchester period. The decisive proof that the α particles are atoms of helium shot off at high speed was obtained by enclosing radium emanation in a very thin tube, and showing that the α particles passing through the glass gave rise to the spectrum of helium in the surrounding space. Single α particles were counted. The spectrum of the β and γ rays was investigated. One of the most fruitful, though at first sight comparatively unimportant, experiments was carried out in 1911 on the scattering experienced by the α particles when they are passing through thin foils of metal. The very large deviations which single particles occasionally undergo were interpreted by Rutherford, as showing that the atom consists, not of a sphere of positive electricity with electrons embedded in it, but of a positively charged nucleus, minute compared to the size of the atom as ordinarily estimated, in which the mass of the atom is concentrated, surrounded by a distribution of electrons comparatively far removed from it. This sun-and-planets model of the atom, usually known as Rutherford's nucleus atom, has had very great success from the point of view of the physicist, and in the hands of Bohr and others has been made to yield astonishing results in connection with spectral series. In 1919 Rutherford went to Cambridge as Cavendish Professor of Experimental Physics, to direct the laboratory where he started his research career. The whitewashing of the laboratory, and a certain liveliness were the immediate results of his appointment. The most important work which he has carried out at Cambridge has been directed to the breaking-up of the nucleus of the atom by utilising the intense local concentration of energy offered by the α particle. By letting α particles pass through atoms of nitrogen, he has been able to show definitely that hydrogen can be obtained from nitrogen as a result of the disintegration of the nucleus, and similar results have been obtained with some other atoms. The quantities of hydrogen thus produced are, of course, so excessively small that only some such method as that employed by him, which deals with individual atoms, could hope to detect it. The *present* practical importance of these experiments is zero: their theoretical importance immense. An actual transformation of the elements has been voluntarily produced; in ordinary radioactive change the transformation is spontaneous. To what advances this may prove the preliminary step it is impossible to predict.

In 1904 Rutherford was awarded the Nobel prize, and in 1921 he was appointed to the post, so honoured by tradition, of Professor of Natural Philosophy, at the Royal Institution. A full catalogue of his distinctions would be wearisome. Probably enough has been said to indicate that he is a man resembling the α particle in his local concentration of energy. He is inimical to leisure. He can arouse enthusiasm for science in anything short of a cow or a cabinet minister. As a theorist, he is capable of bold speculation. There are, of course, plenty of bold speculators, nothing commoner, but Rutherford's speculations differ from the ordinary in proving sound, suggestive, and, above all, capable of a confirmation which is never lacking. This means, of course, that behind the speculation is close thought, and the peculiar flair for truth which is called genius. As an experimenter he is, perhaps, the best man we have had since Faraday, and—we believe—no result of his has ever been called into question, nor has priority ever been disputed when claimed by him. Naturally, his students have boundless confidence in him, and he is not altogether without confidence in himself. Frank and genial in manner, he can discuss almost any subject and smoke almost any tobacco. He is younger in appearance and in spirit than his fifty years, and there seems no reason to suppose that his future achievements may not at least equal his past successes.

On the recommendation of the Aberdeen Corporation Electricity Committee, Mr. HUGH R. BARR, assistant harbour engineer, has been appointed engineer under the contract in connection with the supply of condensing water from the river Dee to the city electricity works.

It is announced in the daily Press that Sir JOSEPH THOMSON, O.M., through the British Ambassador at Washington, will receive the medal of the Franklin Institute, Philadelphia, for notable scientific work. The award describes the celebrated scientist as the "father of modern research for the origin and construction of atoms and molecules."

Mr. E. M. HOLLINGSWORTH, electrical engineer to the United Alkali Co., has been elected a vice-chairman of the Liverpool Sub-Centre of the Institution of Electrical Engineers.

Mr. OXENHAM, of Launceston, has been appointed engineer for the new electric light works at Bideford (Devon.). He has been in charge of a similar plant at Launceston running on sawdust fuel, which is to be used at Bideford.

Mr. C. D. FALCKE announces that, while making future arrangements of his electrical interests, consequent upon the voluntary liquidation of the B.E. Co. (of London and Birmingham), Ltd., of which he has been managing director for the past six years, and of the original business of which in Birmingham he was proprietor for nearly twenty years, business communications should be addressed to him c/o Engineers' Club, Coventry Street, London, W.1. Personal telephone number: "Paddington, 5069."

Obituary.—MR. JOHN TEMPLE, C.B.—We regret to record the death, at the age of 83, of Mr. J. Temple, a pioneer of transatlantic telegraphy. He entered the telegraph service in 1852.

The Times, in referring to Mr. Temple's career, says that, on its formation, in 1856, he joined the Atlantic Telegraph Co., and worked on the staff of Sir Charles Bright, engineer-in-chief, subsequently obtaining a post on board the *Agamemnon* during the laying of the first cable across the Atlantic. In 1859 he was engaged by Messrs. Glass, Elliot and Co., afterwards by the Telegraph Construction & Maintenance Co., and acted as engineer for the Malta and Alexandria Cable and other Mediterranean cable companies. He returned to England in time for the laying, in the summers of 1865-66, of the second Atlantic cable, and was third engineer-in-charge in these expeditions in the *Great Eastern*, under Sir Samuel Canning. Mr. Temple was also in the grappling ship *Albany*, which picked up the first piece of the lost 1865 cable.

On the completion of the two cables across the Atlantic he settled in Liverpool, but, although retiring from the regular service of the Telegraph Construction Co., he acted for

them on several occasions as engineer and agent, and in 1909 completed a service of 50 years with them and their predecessors. In January, 1867, Mr. Temple became managing director of the Warrington Wire Rope Works, afterwards being appointed chairman.

Mr. F. Edwards.—The death occurred on May 10th, at the age of 61 years, of Mr. Frederick Edwards, electrical engineer, of Brooke Street, Dumfries.

Mr. R. E. Graves, C.B.E.—We regret to record the death, which occurred suddenly, on May 21st, of Mr. Robert Ernest Graves, C.B.E., H.M. Chief Inspector of Factories since 1920. Mr. Graves was a Government inspector of factories as long ago as 1890, and he served on important committees during the war. He was born in 1866.

In paying a tribute to Mr. Graves in the House of Commons on Tuesday, the Home Secretary mentioned that his sudden death might delay the issue of his annual report, as although Mr. Graves had brought it near to completion, further revision was still required, but that would be carried out as speedily as possible.

CITY NOTES.

British Thomson-Houston Co., Ltd.

The report for the year 1921 states that the buildings and machinery at the works at Rugby, Birmingham, Coventry, and Willesden have been maintained in good condition. The extensions to the Rugby works, which were begun in 1919, have practically all been completed. The changes in the works at Birmingham have all been carried out and the works are in operation. No new works were begun during 1921, and the amounts expended during the year were principally in connection with the completion of the extensions at Rugby, and in connection with glass works which are being erected at Chesterfield. It is expected that the latter will be completed during the current year. Due to the expansion of the company's business, the accommodation at the old offices in London, at 83, Cannon Street, E.C., was found to be inadequate. These have been given up and more commodious offices taken at Crown House, Aldwych, W.C.2. The profits for the year, after deducting all expenses and charges other than interest on debentures and loans, were £509,259, plus £225,892 brought forward, making £735,150. Less interest on debentures and loans £119,446. There is to be appropriated for depreciation, reserves, &c., £160,000, and the following dividends for the year are recommended: 7 per cent. free of income tax on the preference shares, £105,000; 6 per cent. free of income tax on the ordinary shares, £120,000; leaving to carry forward £230,704. Arrangements on reasonable terms are practically completed with the holders of the preference shares, whereby from January 1st, 1922, the dividends thereon will be at the rate of 7 per cent. per annum, subject to income tax. During the year the directors arranged for the issue of £1,500,000 par value 7 per cent. mortgage debenture stock, being part of an authorised issue of £3,000,000. The issue was largely over-subscribed. From the proceeds the company's indebtedness was substantially reduced, and since December 31st the entire amount due to the International General Electric Co. Inc. has been paid off. Under the terms of the trust deed securing the issue of the company's 4½ per cent. debenture stock the company, since the beginning of this year, has paid to the trustees £5,565, which was applied by them in redeeming at 105, by drawings, £5,300 of that stock. The total par value of said debenture stock redeemed to date is £65,005, which leaves a net amount outstanding at the date of this report of £146,995. The amount outstanding at December 31st, 1921, was £152,295. Since the beginning of the year £7,500 par value of the new 7 per cent. debenture stock has also been retired. The Rt. Hon. Earl Buxton, G.C.M.G., has been appointed a director. Mr. W. C. Fish has resigned from the board, due to continued absence, and his resignation was accepted with regret.

Meeting: London, May 30th.

Lancashire Electric Light and Power Co., Ltd.

The annual general meeting was held on May 17th. Mr. Alfred Shepherd (chairman), in moving the adoption of the report and accounts, said that it would be noticed from the balance sheet that the amount of debentures of the Parliamentary Co. issued was exactly one-third of the Parliamentary Co's. shares held; this was the limit of that company's borrowing powers. A large amount of the Parliamentary Co's. earnings was applied to the paying of interest and discount on its outstanding debt, which had now been taken over by their company. Next year the contributions from the Parliamentary Co. should show very material increases. It was satisfactory to note the results obtained by the Parliamentary Co., notwithstanding the disputes and depression in the coal and cotton trades, and trade in general. The working costs were the lowest in the Lancashire district, and compared favourably with those of any other power company in the country. Regarding the re-organisation of electricity supply, he was glad to say that the Commissioners had intimated their intention of authorising a voluntary joint advisory committee for the area, as suggested by the company, instead of constituting a joint electricity authority. It was significant that in that district—probably the best suited for a joint authority if such was necessary—the Commissioners, after full consideration, had approved the alternative scheme. Referring to the Electricity (Supply) Bill recently passed by the House of Lords, Mr. Shepherd said that, although amendments had been made to safeguard the interests of power companies, he could not help feeling that the electrical industry should be free from Parliamentary interference. In conclusion, the chairman said that future prospects seemed bright. The motion was seconded by Mr. George Balfour, M.P., and carried unanimously. The retiring directors and auditors were re-elected.

French Companies.

The *Société Centrale pour l'Industrie Electrique*, which is an electrical investment company, reports net profits amounting to 1,277,000 fr. for 1920-21, and a dividend at the rate of 25 fr. per share.

The *Société d'Electro-Chimie de Bozel* reports net profits of 479,000 fr. for 1921, and with the balance forward the sum available for disposal is 983,000 fr. A dividend at the rate of 8 per cent. has been declared.

The Société Francaise des Electrodes reports that the general crisis was particularly experienced by the company in 1921, and the drought was also another factor which contributed towards the diminution of business, as many contomers for this reason were compelled to reduce their production. The net profits, which amounted to 1,145,000 fr. in 1920, declined to 404,000 fr. last year, and the dividend is at the rate of 25 fr. gross per share.

Indian Electric Supply and Traction Co., Ltd.

Mr. J. G. B. Stone (chairman), presiding at the annual meeting on May 22nd, said that although the company's earnings in Cawnpore had increased, the fall in the exchange value of the rupee had had an adverse effect. Owing, however, to prudence in the past, last year's dividend was maintained. A new station had been erected on the banks of the Ganges, with an initial capacity of 6,000 kW, but owing to delays in delivery of the plant it would not be possible to commence running before August. Debentures to the extent of £250,000 had been issued to provide funds for the further extension of this station and to include the conversion and repayment of outstanding debentures.

Shanghai Electric Construction Co., Ltd.

The directors report that the operating profit for 1921 was £93,080, as compared with £85,119 for 1920. The reduction in the credit on exchange account is to a large extent offset by the termination of Excess Profits Duty. The total profit was £112,945, and £9,416 was brought forward. There is put to reserve for renewals, £10,000; provision for Corporation Profits Tax, £5,000; general reserve, £20,000; expenses of bonus share issue including stamp duty on new capital, written off, £1,100. The directors recommend a final dividend of 8 per cent., less income tax (making 20 per cent. for the year), leaving to be carried forward, £6,261. The loss by depreciation of subsidiary coinage in 1921 was £93,731, which is equal to 23.43 per cent. on the capital. The ratio of coinage depreciation to gross takings increased during the year, and still shows an unfavourable tendency. The traffics and net receipts for the current year continue to be satisfactory, showing an increase over any corresponding period. Negotiations with the Municipal Council for the extension of the company's system under railless electric traction, and for additional track facilities, to permit of an augmented service, are well advanced. A provident fund for the benefit of the European staff in Shanghai has been inaugurated.

Siemens Bros. and Co., Ltd.

In their report for 1921, the directors say that the company has not escaped from sharing in the general depression in trade which began to affect its business about the middle of 1921, and which still continues. This depression was particularly reflected in the order-sheet for the year, which showed a heavy falling off from the values of orders secured in recent past years. A full share of orders in the market was obtained, but demands have become scarce and many large inquiries failed to materialise into orders. Fortunately, however, the contracts in hand from 1920 enabled output to be maintained almost on the previous year's level, except in the case of the submarine telegraph cable shop, where work became scanty in the latter months of the year, but where prospects are now better. A reduction in the output of lamps from the company's Dalston factory was necessary owing to the general depression also affecting the lamp trade, and to the dumping of Dutch lamps on the English market and Colonies, but the dumping has now been effectually stopped, so far as gasfilled lamps are concerned, by a recent judgment in the House of Lords upholding an important patent in which the company is interested controlling the manufacture of such lamps in this country. The

company's overseas business is being fostered and developed, its own representatives having been established in the more important Colonies and in India, while agents have been appointed in other likely situations for business. No definite assessments have yet been made for the company's liability to Excess Profits Duty for the years 1918, 1919, and 1920, but a sum of £100,000 was paid during the year in respect of same. The profits for 1921 are not liable to the duty. The profit for the year is £200,994, and there was brought forward from 1920 £437,218.

The interim dividend of 1s. per share required £75,000; Corporation Profits Tax for 1920, and 1921 £29,100; payments on account of Excess Profits Duty £100,000; leaving profit available £434,112.

This is to be appropriated as follows:—Half-year's dividend to December 31st, 1921, on £300,000 10 per cent. cumulative preference shares created during 1921, £15,000; a final dividend of one shilling per share on £1,500,000 of ordinary shares making 10 per cent. for the year, free of income tax, £75,000; to write off book value of s.s. *Faraday*, £10,000; carrying forward to 1922 (subject to balance of Excess Profits Duty for 1918, 1919, and 1920), £334,112. Sir W. R. Lawrence, Bart., who was a director of the company from 1907 to 1914, was invited to rejoin the board, and did so in July, 1921.

Anglo-Argentine Tramways Co., Ltd.

The gross receipts for 1921 were £4,277,601, and the expenditure was £3,305,081, leaving £972,520, plus £14,474 for interest on investments and deposits, &c., making £986,993. From this are deducted annuity to City of Buenos Ayres Tramways Co. (1904),Ltd., £70,660; interest and sinking funds on debenture stocks, £587,821; sinking fund for redemption of preference and ordinary shares, £7,587; and loss on sale of war stock, £17,279; leaving £303,647, plus £15,884 brought forward. Dividends on the 5½ per cent. cumulative first preference shares for the year ended December, 1921, require £176,000; a dividend on the 5½ per cent. cumulative second preference shares in satisfaction of six months' arrears to June 30th, 1917, absorbs £68,750; and a further dividend on these shares in satisfaction of six months' arrears to December 31st, 1917, which the directors now recommend, will require £68,750, leaving to be carried forward £6,032. The receipts from passenger traffic amounted to £4,206,437, an increase of 5 per cent. over the previous year. The number of passengers carried was 439,133,491, against 432,636,355 in 1920. The working expenses amounted to 76.25 per cent. of the receipts, as compared with 75.60 per cent. last year, and 79.91 per cent. in 1919. The traffic expenses were £1,223,358, against £1,158,265, chiefly owing to increases in wages caused by the high cost of living. The traction expenses showed a substantial reduction, being £644,724, as compared with £812,693 in 1920, although the abnormal price of fuel continued to have an adverse effect upon operating costs. The renewals expenditure during the year was £166,789, which has been charged to revenue. The allocation to renewals reserve from revenue in 1920 was £133,172, and, in 1919, £97,000. The annual expenditure for renewals is necessarily a fluctuating amount. While circumstances have rendered it larger this year than usual, the board did not feel justified in drawing on the renewals fund, which, in their opinion, it is desirable to strengthen. The reduction in net receipts, as compared with last year, is due to additional wages and maintenance charges, increases in cost of renewals, rates, taxes, and administration expenses in Buenos Ayres, and in the company's contribution to the official pension fund, which amounted, in the year under review, to £109,302, and to fluctuations in exchange and the absence of the benefit derived in the previous year from the adjustment of tax on payment of dividend arrears. Major-General Sir Frederick Sykes, G.B.E., K.C.B., C.M.G., has been elected a director. Owing to pressing business engagements, Major James E. Dunning, D.S.O., has ceased to be a member of the board.

In the course of his usual report on the situation in the Argentine, the general manager says: "On the whole I consider it probable that matters will improve slightly, but very gradually during the present year, and I do not think we shall be able to count upon an increase of much over 4 per cent. on 1921. Working expenses should improve, however, owing to the drop in the cost of fuel, which will be very marked this year compared with 1920 and 1921."

Belgian Companies.

The *Société Générale Belge d'Entreprises Electriques*, which is an investment company, reports that the situation of the electrical supply undertakings had improved since they had been able to increase the tariffs in accordance with existing conditions. The net profits realised in 1921 amounted to 2,404,000 fr., and a dividend at the rate of 7 per cent. has been declared (35 fr. per share less the tax of 10 per cent.).

The report of the *Compagnie Générale de Railways et d'Electricité* states that although the economic crisis became accentuated in 1921, the results achieved by the company could be considered very satisfactory and the future outlook presented a favourable aspect. As an investment undertaking the company's interests are centred in transport, the supply of gas and electricity, and manufacturing companies. It had been possible for most of the transport and supply companies to secure permission to raise their tariffs so as to bring them into relation with present conditions, while the manufacturing branches had passed through the crisis without injury, had plenty of orders, and had yielded satisfactory results. After having written off 1,941,000 fr., including the claims on Russian transactions, the accounts show net profits of 1,811,000 fr. for 1921, permitting of the payment of a dividend at the rate of 4 per cent.

The report of the directors of the *Ateliers de Constructions Electriques de Charleroi* states that while the first half of 1921 yielded results which were entirely satisfaciory, the last months revealed the growing influence of the unfavourable factors which at present burden business. It had so far been possible for the company to cope with events by constant improvements in the methods of working, and by the development of the commercial organisation. But these efforts would, perhaps, no longer be sufficient to remove the serious consequences which the prolongation of the crisis was bringing about unless measures were taken to deal with the situation. The rates of wages, higher in Belgium than anywhere else, and the reduction in the working day, caused the cost prices to be maintained at an excessive level, and rendered it increasingly difficult to sustain the contest with foreign rivals having cheaper skilled labour and a depreciated currency. Under these circumstances it was necessary to proceed with a readjustment of the costs of production in order to prevent the electrical industry from experiencing the serious difficulties which assailed other branches of national activity at present. The existing situation was rendered still more serious by the fact that many external markets were being closed by the introduction of high protective tariffs, whereas the Belgian import duties did not even permit the Belgian makers to compete on equal terms in their home market. For instance, the import duties on manufactures were lower than for raw materials and semi-finished products in the case of mechanical and electrical construction work. After mentioning that the restoration of the works and plant damaged by the Germans was continued during the year, the report states that efforts were put forth to extend the markets both at home and abroad. In the latter case agencies and stock depôts had been established in England, Holland, Switzerland, Brazil, and in the Grand Duchy of Luxemburg. Among other plants the company delivered two flywheel alternators of 6,600 to 8,000 kW, 6,000 volts, and driven by blast-furnace gas engines, a continuous-current generator of 5,000 kW, 550 volts, also operated by a gas engine, and a complete installation of blooming mill trains of 15,000 horse-power. The accounts show net profits of 5,767,000 fr. and a dividend has been declared at the rate of 7 per cent. (17.50 fr. per share less tax of 10 per cent.).

German Companies.

The report of the *Bergmann Electricity Works Co.* states that notwithstanding various fluctuations, it was possible considerably to increase the turnover in 1921 as compared with the previous year. The machine department was assisted by the new Münich-Freimann works, which was in full operation; and abundant occupation was provided by the progressive electrification of agriculture. Concerning the export trade, the report states that sales experienced a difficult course, but it was nevertheless possible to increase the exports as a result of the more intensive activity of the newly created agencies. The financial results (20 per cent. as against 15 per cent. in 1920) have previously been reported. During the first quarter of 1922 it is mentioned that the turnover has further increased, and the augmentations in the orders will occupy the works for months forward.

The report of the *Voigt & Haeffner Co.*, of Frankfort-on-Main, states that great extensions of the works were begun in July, 1921, and that the new shops would be gradually brought into use in the summer of 1922, when it was hoped to be able to deal with the extraordinarily large accumulation of orders. The foundry at Kesselstade was also considerably enlarged. After writing off 1,620,000 marks for depreciation, as against 790,000 marks in 1920, the accounts show net profits and balance forward amounting to 13,946,000 marks, as contrasted with 13,530,000 marks in 1920. It is proposed to pay a dividend at the rate of 20 per cent. on share capital of 30,000,000 marks, this comparing with the same rate on 10,000,000 marks in 1920. As to the future, the directors remark that while it is difficult to make any prediction, the new financial year should also show favourable results, having regard to the large stock of orders and the great problems still confronting the electrical industry in almost all countries.

Rheinisch-Westfälisches Elektricitatswerk.—The report stated that for the creation of the means for the further extension of the undertakings, combined with the continued depreciation of the currency, the management had decided to increase the share capital from 150,000,000 marks to 550,000,000. The issue of 125,000,000 holders' shares had already been made. Of this issue, shares to 30,000,000 marks had been offered to the old shareholders in the ratio of one new to every five old shares, and at the price of 100 per cent. The remaining 95,000,000 shares would be allotted to the Brikettwerk-Roddergrube-Akt. Ges. and the Essen hard coal concerns to strengthen the expectations looked for in those quarters. Each shareholder in the Roddergrube company would be allotted two R.W.E. shares against one of the

Roddergrube company. To retain and secure the continuance of the commercial connection there would, at the same time, be offered to communal shareholders shares to 250,000,000 marks at their face value. These nominal shares, as well as the original shares, would be entitled to 5 per cent. dividend. A further 25,000,000 nominal shares would be offered to the workers of the Rheinisch-Westfälisches Elektricitätswerk on the same terms, in order to make a practical attempt to still further interest the workers in the undertaking. This is the first concern to essay the Socialist ideas of Herr Hugo Stinnes, who himself is president of the directorate. It was foreseen by him and others that the only means of stemming the rising tide of the workers' Socialist aims was to give the latter a share in the undertaking's capital by means of workers' shares. It was a private attempt to solve a difficulty in an economic way which came up against the almost unanimous resistance of the workers, but which would probably succeeed, as had been the case at the Krupp works.

Kabelwerk Rheydt Aktien Gesellschaft.—It has been decided to raise the capital of this company from 35,000,000 to 85,000,000 marks. Of the new shares 25,000,000 marks' worth are to be offered to the shareholders.

The directors of the *Accumulator Works Co.*, of Berlin and Hagen, recommend a dividend at the rate of 25 per cent. for 1921, or 5 per cent. higher than in the preceding year.

The *German Cable Works Co.*, of Berlin, reports an increase in the net profits from 3,172,000 marks in 1920 to 6,191,000 marks last year. The dividend is at the rate of 20 per cent. on 40,000,000 marks, as against 17 per cent. on ordinary shares for 12,000,000 marks in 1920.

The *United Insulator Works Co.*, of Pankow, Berlin, after having written off 121,000 marks for depreciation in 1921, reports net profits of 430,000 marks, as against 393,000 marks in the previous year. The dividend is at the rate of 12 per cent., as in 1920, and the share capital is to be raised by 4,000,000 to 7,000,000 marks.

The *Duisburg Cable Works Co.*, of Duisburg, reports net profits of 3,066,000 marks for 1921, as compared with 2,950,000 marks in the previous year, when a dividend at the rate of 25 per cent. was paid. It had been intended to distribute the same rate for 1921, but the proposal to this effect was withdrawn at the annual meeting, and most of the profits placed to the contingency fund. The share capital is to be increased from 12,000,000 to 36,000,000 marks.

The Electrical Undertakings Co., of Berlin, whose investments also comprise manufacturing works, reports net profits of 17,339,000 marks for 1921, as compared with 8,770,000 marks in the previous year. The dividend is at the rate of 20 per cent. on share capital of 75,000,000 marks, as against 8 per cent. in 1920.

The Concordia Electricity Co., of Dusseldorf, reports that it was possible to re-establish pre-war relations in 1921. Having made provision for depreciation, the accounts disclose net profits of 2,657,000 marks, as compared with 1,111,000 marks in 1920. It is proposed to pay a dividend at the rate of 12½ per cent. on share capital of 18,000,000 marks, comparing with 15 per cent. on 12,000,000 marks in the previous year.

The Land & Marine Cable Co., of Cologne-Nippes, reports an increased turnover for 1921 and gross profits of 8,999,000 marks, as compared with 8,048,000 marks in the previous year. After having made provision for depreciation, &c., the net profits are returned at 2,213,000 marks, as against 2,706,000 marks in 1920, and the dividend remains at 20 per cent., as in 1920. The share capital is now to be increased by 4,000,000 marks, and the issue will be taken over by the Felten & Guilleaume Co., which is already largely interested in the undertaking.

Swedish Companies.

The *Elektriska A.B. Eck* reports a loss of 1,504,000 kr. for 1921, which is reduced by 10,000 kr. by the appropriation of the reserve fund and the rest has been carried forward. There was a loss of 290,000 kr. in 1920 and one of 910,000 kr. in 1918.

The *Telefon A.B. Cedergren* states that the working of the telephone network in Warsaw was carried on for the account of the new company, which has to pay interest on the purchase price of the company's assets in Warsaw from January 1st, 1921. A loss of 1,420,000 kr. was incurred as compared with 900,000 kr. in 1920, thus increasing the total loss to 7,800,000 kr.

The directors of the *Swedish-Danish-Russian Telephone Co.* report that since the end of 1920 they had endeavoured to get into negotiation with the Russian authorities respecting payment for the company's telephone network in Moscow. It had, however, not yet been possible to get the matter fully discussed with the competent authorities, so that no opinion could be expressed regarding the future prospects. Concerning the Cedergren Telephone Co.'s activity in Poland, the report states that the provisional agreement with the Polish Government was not converted into a definite agreement by the end of the past year. The accounts show a loss of 1,550,000 kr. for 1921, which is due to the payment of interest on loans. The loss has been carried forward, thus increasing the deficiency since 1917 to 5,610,000 kr.

Johnson and Phillips, Ltd.

The report submitted at the annual meeting held yesterday, Thursday, showed that the profit for the year ended December, 1921, on trading accounts, &c. (including claim for repayment of Excess Profits Duty), after making provision for bad and doubtful debts, and after charging to revenue upwards of £16,000 for maintenance of buildings, plant, &c., was £42,737 plus £70,394 brought forward.

Deducting the dividend paid May 30th, 1921 (less tax), £38,281; and a bonus of one per cent. on first mortgage debenture stock (less tax) £446; there remains £74,404 which is to be dealt with as follows:—Remuneration of directors, and auditors' and trustees' fees, £1,671; interest on five per cent. debenture stock to date of redemption, £1,725; interest on 8 per cent. debenture stock to December 31st, 1921, £14,000; reserve re five per cent. debenture sinking fund, £4,788; interest on second debentures to date of redemption, £1,280; interest on loans, £5,119; income tax and corporation profits tax (estimated), £18,428; depreciation on machinery and plant, &c., £12,255; leaving to be carried forward, £15,138. "The profits on this year's business would have compared quite favourably with last year, but for the heavy fall in prices of stocks and work in hand, which necessitated the writing down of values to current market prices. In view of the present state of trade caused by the engineers' lock-out, and the consequent falling off of business, your directors do not recommend the payment of a dividend on this occasion."

Scarborough Electric Supply Co., Ltd.

Supplementing our previous reference to the report, we may state that, during 1921, 408 new consumers were added, and the new connections to mains were 15,405 30-watt lamps, making a total of 176,636. Units supplied 1,727,126, an increase of 272,749. The dividend of 2½ per cent., already mentioned, cannot be paid until it has been approved by the Electricity Commissioners; there may therefore be some delay in paying it. As at present prices and with existing costs of coal and labour, it is manifestly impossible for the company to earn reasonable profits, the directors have applied to the Electricity Commissioners for powers to charge higher prices, and an early decision is expected.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be officially quoted:—Midland Counties Electric Supply.—500,000 7½ per cent. mortgage debenture stock.

The under-mentioned securities have been ordered to be officially quoted:—

Jutland Telephone.—Scrip, fully paid, for £500,000 5½ per cent. sterling bonds (guaranteed by the Danish Government).

Birmingham District Power and Traction Co., Ltd.—The directors' report for 1921 shows (according to the *Financier*) a net surplus of £62,840, making £67,348 with the amount brought in. After deducting interest on debenture stock, &c., there is left £25,657, out of which a dividend at the rate of 6 per cent. is proposed on the ordinary shares, leaving £2,981 to carry forward.

Havana Electric Railway, Light and Power Co.—The report for 1921 shows gross earnings $12,882,652, operating expenses and taxes $7,376,343, net income $5,506,309, miscellaneous income (net) $122,766, total net $5,629,075, of which first charges absorbed $1,009,011, leaving net profits $4,620,064. To reserve for depreciation and contingencies $1,923,879, leaving a balance of $2,696,185, plus $3,629,099 brought in, making $6,326,084. Dividends paid (6 per cent. on preferred stock and 6 per cent. on common stock) absorbed $2,155,579; carried forward, $3,781,040.—*Financial News.*

West Coast of America Telegraph Co., Ltd.—After providing £7,550 for income tax and corporation profits tax, the credit balance is £20,828, making, with £5,696 brought forward, £26,524. £6,000 is required for preference dividend, £10,000 is put to general reserve, and £5,000 to maintenance ship's reserve fund leaving £5,524 to be carried forward.

Rhondda Tramways Co., Ltd.—The ordinary general meeting of this company was held on May 18th, Mr. Harold T. Barnett presiding. The report was adopted. The election of Mr. E. Morley to the board to fill the vacancy caused by the death of Mr. Schlesinger, chairman of the company, was confirmed.

Brisbane Electric Tramways Inevstment Co., Ltd.—After paying the debenture interest and preference dividends, balance dividends of 4s. per share, tax free, are declared, making 8 per cent. for the year, tax free. £46,163 carried forward.

Oriental Telephone and Electric Co., Ltd.—Final dividend of 6 per cent. (free of tax) on the ordinary shares, making 10 per cent. (free of tax) for the year 1921, and a bonus of 2 per cent.

Rees-Roturbo Manufacturing Co., Ltd.—Dividend of 5 per cent., less tax, on the preference shares for the year ended September, 1918. To depreciation reserve £2,000; to taxation reserve £1,013; carried forward £1,567.

British Electric Traction Co., Ltd.—The directors recommend, subject to audit, a dividend of 4½ per cent. upon the ordinary stock for the year ended March 31st, 1922. The dividend for the previous year was 4 per cent.

La Plata Electric Tramways, Ltd.—After providing for debenture and other interest, the accounts for 1921 show a profit of £2,720, plus £14,531 brought forward. £10,000 is put to reserve fund, and £7,251 is carried forward, subject to corporation profits tax, if any.

Globe Telegraph & Trust Co., Ltd.—Final dividend of 5s. per share on the ordinary shares.

Glenfield & Kennedy, Ltd.—A final dividend of 5 per cent. on the ordinary shares is declared, making 7½ per cent. for the year.

STOCKS AND SHARES.

TUESDAY EVENING.

THE summer weather is being blamed as the principal opponent to that activity in Stock Exchange markets which had been hoped would follow from the release of the war-time restrictions under which business had laboured during the last 7½ years. It must be candidly admitted that the volume of orders had not proved of noticeably greater dimensions this week, in spite of the fact that the public are now at liberty to enter upon speculative engagements to an extent which has hitherto been denied them since the outbreak of war. In some few departments round the Stock Exchange, a little increase of activity is reported, this being the case more particularly with shares of the purely speculative order, but with regard to investment descriptions the benefit which will accrue from the added flexibility given to the Stock Exchange, through the introduction of bi-monthly settlements, has not had time to make its influence felt. The result is that prices are practically uninfluenced by the new conditions which came into force on Monday.

The report of Siemens Brothers, for 1921, caused the ordinary shares to fall from 29s. to 28s., though the preference moved up to 31s. 6d. Compared with the Johnson & Phillips result, which showed the ordinary dividend to be passed, Siemens may be said to have done well, although the profit of £201,000 is about £52,000 lower than in the previous twelve months. There is, of course, much more capital to-day upon which dividend has to be earned, but the 10 per cent. free of tax is maintained, and it seems probable that, when the immediate effect of the report has worn off, there will be a recovery in the price. Electrical manufacturing concerns have had, on the whole, a good year, though in well-informed quarters the suggestion is advanced that the current year may turn out to be less profitable than its predecessor, a statement which insiders have more opportunity for testing than the ordinary observer who merely deals in, and writes about, the shares in such companies. A good deal of interest is felt in the forthcoming dividend announcement by the General Electric Co.; anticipation is rather inclined to look for a repetition of the usual 10 per cent. dividend on the ordinary shares. Prices in this section are steady without showing any particular movement other than that in Siemens. The net loss in the latter on the week is about 9d. a share.

The British Electric Traction Co. proposes payment of a dividend of 4½ per cent. on the ordinary stock for the year ended last March, this being ½ per cent. more than the dividend for the preceding period. The ordinary is a good market at 50½ and the preference stands at 89. London and Suburban preference hold their gain at 8s. 6d. London United Tramways at 3s. 3d. are a trifle better.

The premium on the Calcutta Electric Traways 7 per cent. second debenture stock has advanced to 4¼, there being steady pressure to buy the stock on the part of the speculative investor who does not object to the Indian flavour, but who looks to the security, which, according to the prospectus, is ample to cover the issue. Allotment letters of the Indian Electric Traction 5 per cent. free-of-tax debenture came out to-day, Tuesday, and the price is quoted at 1½ premium. A new Madras Electric issue will be announced at the end of this week.

Lively excitement in the Marconi market attended the rise in the parent shares to 2½ buyers, Marines keeping them company with a jump to 37s. As already mentioned, it is thought that the company's claim against the Government will come on for adjudication next month, and this serves to quicken an attention already kindled by the development of radio-telephony, from which the company is said to be likely to derive substantial benefit. Canadian Marconis spurted to 13s. 9d., but Radio Corporations ordinary lagged behind at 22s. 6d., the preferred remaining about 15s. 6d. Cable stocks eased off on account of the advertisement given to the wireless group. Eastern stocks are lower, and Great Northerns shed 15s.

Home Railway stocks are strong, with Metropolitans at 45½ as one of the active features in the market. Districts have fallen behind the rest, interest in them being subservient to that taken in the stocks which pay high rates of dividends. Underground Electrics keep their prices. Of the foreign stocks, Brazilian Tractions stand out the most prominently, with a gain of 6 points at 55. This is due to buying, largely from the country, based on the assumption that it will not be long before the company resumes quarterly dividends of 1 per cent. on the common shares. The preferred at 93½ show a gain of 2. Anglo-Argentine Tramways preference shares are lower, some disappointment being caused by the issue of the report. It had been hoped that the arrears of dividend on the second preference shares would be practically cleared off, but this is not the case, and the report shows that something of a setback befell the company's fortunes last year, though it was not of sufficient consequence to affect the general outlook for the future. British Columbia issues are a little irregular. Mexican Light common fell three dollars, the preferred two, owing to the entire lack of news with regard to the negotiations said to be still progressing between Mexico City and Washington. Indian Electric Tramway and Supply shares are generally rather better.

Of the London electricity shares, Kensingtons show the substantial rise of 10s., Westminsters and Charing Cross are both 7s. 6d. up, and Londons at 1½ are 5s. higher. A few of the preference shares are better. Buyers clamour for shares, and there is very little supply to meet the demand. Smithfields are higher at 3½.

In the manufacturing companies' list, General Electrics are easier at 21s. 9d., on rumours that the company has sold, or is about to sell, a fairly substantial line of "A" and "B" preferences, the aggregate, according to rumour, being something like £250,000. It is not expected that these will be offered to the shareholders. Common report has it that the lot was taken entire by certain financial interests in the North and the Midlands. Cromptons have gone back to 1, the preference to 21s. 3d., but English Electrics at 15s. x.d. have recovered most of the dividend. British Aluminium advanced to 18s. 9d. The rest of the list is steady. Babcock and Wilcox at 3½ are the fraction to the good. The rubber market is stagnant, and the continued engineering lock-out precludes any activity that might otherwise come about in the shares of the iron, steel, and armament companies.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend. 1920.	Dividend. 1921.	Price May 23, 1922.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	12	12	7½	—	£8 0 0
Charing Cross Ordinary	8	9	6⅝	+ ⅜	6 11 0
do. do. 4½ Pref.	4½	4½	3⅞	—	6 0 0
Chelsea	6	6	5⅝	—	5 6 8
City of London	14	14	38/-	—	7 7 4
do. do. 6 per cent. Pref.	6	6	22/6	—	5 6 8
County of London	8	8	1¼	—	6 8 0
do. do. 6 per cent. Pref.	6	6	1	—	6 0 0
Kensington Ordinary	9	10	7⅛	+ ⅛	7 0 7
London Electric	2½	4	9	+ ¼	6 0 4
do. do. 6 per cent. Pref.	6	6	4½	+ ½	6 6 4
Metropolitan	7	7	5¼	+ ¼	6 13 4
do. 4½ per cent. Pref.	4½	4½	3½	—	6 0 0
St. James' and Pall Mall	12	12	8½	—	7 5 5
South London	7	7	5¼	—	8 0 0
South Metropolitan Pref.	7	7	1⅞	—	5 18 0
Westminster Ordinary	10	10	7⅛	+ ⅛	6 15 7
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref	6	6	108	+ ½	5 16 6
do. Def.	1½	34/6	24	— ½	7 4 0
Chile Telephone	6	6	6¼	—	4 16 6
Cuba Sub. Ord.	7	7	8⅝	—	8 4 8
Eastern Extension	10	10	188xd	— ½	5 6 8
Eastern Tel. Ord.	10	10	190½xd	— 1½	5 5 0
Globe Tel. and T. Ord.	10	10	18⅝	— ⅛	5 7 6
do. do. Pref.	6	6	11½	—	5 7 0
Great Northern Tel.	22	24	30½	— ½	7 18 5
Indo-European	10	10	40½	—	6 3 5
Marconi	25	15	2½	+ 1/8	5 2 0
Oriental Telephone Ord.	12	12	25	—	*5 1 1
United R. Plate Tel.	8	8	7½	—	*5 6 8
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	18⅞xd	— ⅛	*5 6 8
HOME RAILS.					
Central London Ord. Assented	4	4	68	—	5 17 8
Metropolitan	1½	2½	45½	+ ½	4 19 0
do District	Nil	1	37½	—1	2 13 4
Underground Electric Ordinary	Nil	Nil	2½	—	Nil
do. do. "A"	Nil	Nil	7/-	—	Nil
do. do. Income	2	4	80½	—	*4 19 5
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref.	5½	19½	3⅞	— 1/8	7 11 8
do. do. 2nd Pref.	Nil	5½	3¼	— ¼	7 2 0
do. do. 5 per cent. Deb.	5	5	83½xd	—	6 1 3
Brazil Tractions	Nil	Nil	55	+6	Nil
British Columbia Elec. Rly. Pcc.	5	5	8½	+2	6 1 3
do. do. Preferred	5	93/-	70½	—1	*6 11 6
do. do. Deferred	3	19½/-	7½	—	*8 7 6
do. do. Deb.	4½	4½	77	+4	5 10 5
Mexico Trams. 5 per cent. Bonds	Nil	Nil	7½	—	—
do. do. 6 per cent. Bonds	Nil	Nil	8⅝	—	Nil
Mexican Light Common	Nil	Nil	22½	—3	Nil
do. Pref.	Nil	Nil	52	—2	Nil
do. 1st Bonds	Nil	5	74½	—	6 14 2
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	16	3½	+ ⅛	5 2 3
British Aluminium Ord.	10	10	⅞	+ 1/16	—
British Insulated Ord.	15	15	2⅛	—	7 5 3
Callenders	15	15	2⅛	—	7 7 9
„ 6½ Pref.	6½	6½	1⅞	—	5 9 5
Crompton Ord.	10	10	20/-	—2/-	10 0 0
Edison-Swan	10	—	5/-	—	—
do. do. 5 per cent. Deb.	5	5	64	—	7 16 4
Electric Construction	10	10	1¼	—	8 0 0
English Electric	8	8	15/-xd	+9d.	6 13 4
do. do. Pref.	6	6	18/3	—	6 11 6
Gen. Elec. Pref.	6½	6½	22/9	—	5 14 3
do. Ord.	10	10	21/9	— 1/16	9 11 10
Henley	15	15	2⅛	— 1/8	7 5 3
do. 4½ Pref.	4½	4½	4⅛	—	5 4 4
India-Rubber	10	—	⅜	—	—
Met.-Vickers Pref.	8	8	2½	—	6 8 0
Siemens Ord.	10	10	28/-	—9d.	*7 2 10
Telegraph Co.	20	20	26	—	*4 12 6

* Dividends paid free of Income Tax.

THE FINANCING OF ELECTRICITY SUPPLY UNDERTAKINGS.

By C. W. CHARLESWORTH.

The difficulties encountered in the financing of an electricity supply undertaking, which are not present in such an acute form in any other industry, create obstacles to that quick and successful expansion vital to manufacturing and domestic interests dependent upon electricity supply. Discussion of the questions arising, some of which have been recently raised, is, therefore, opportune at the present time, when all sections of the community are endeavouring to recover from the unfortunate effects of the late war.

When considering such questions, other matters which are connected or interact therewith must necessarily be raised, but the introduction of these elements often obscures the plain facts, and if caution is not displayed distorts the final conclusions to such an extent that comparisons made between one method and another of raising, rewarding, and maintaining capital are rendered almost worthless.

Every undertaking to be successful must effectively deal with the following matters of first importance:—

1. Provision of a reliable service throughout the supply area, so that electricity may be available generally in sufficient quantities.
2. Reduction of costs to make possible supply at such a low price that it will, apart from inherent advantages, successfully compete with other forms of lighting, power, and heating.
3. Preservation of the plant, mains, and other assets in an up-to-date condition, replacing those obsolete, and maintaining those retained in use in the highest practicable state of efficiency.
4. Extension and development in order efficiently to meet the increasing demands awaiting satisfaction.

Behind every one of these questions is the need for a sufficient amount of capital, and starting with this as a base it must be granted that the future of the industry rests largely upon the amount of capital it can command.

The cost of capital, like the cost of anything else, is obviously what it is necessary to pay to obtain it; but it might help to be a little more precise. There are two components in capital charges:—

1. The reward which the investor requires to induce him to allow his rights to be subrogated to others.
2. The maintenance of these rights, or, which is the same thing, conservation of the buildings, plant, mains, &c., representing them.

In the case of companies, the first item is represented by dividends, or, what is often more to the point, the prospect of dividends. In the case of municipalities this item is covered by interest payable. In both cases there is sometimes a further inducement by the offer of issues at a discount.

The second item is always represented by provision against depreciation and obsolescence. Companies may allow for this by a general depreciation fund, while municipalities meet the needs by their sinking funds, which serve the same purpose.

Having thus defined the conditions, consideration will be given to the same in some detail, examining the two aspects separately.

Companies, in raising share capital, issue prospectuses, giving therein information calculated to persuade investors to acquire a part ownership of the concern, and the promptness with which money is risked in response will be considerably influenced by the dividends expected to be enjoyed. Assume investment made and dividends received: well and good. It may be, however, because of trading losses, or the need for a constant stream of fresh capital into the concern, that there are no dividends, and, indeed, no prospect of dividends; then the position is not so enviable. In the first case shareholders may, or may not, recover. In the second case they will probably be told that it will be wiser to accept the directors' decision to divert any surplus towards extending the operations of the undertaking; and so time goes on, until, with shares possibly standing below par on the Exchange, and having received no return for a number of years, at least a doubt creeps into their minds as to whether, after all said and done, they might not have been better advised to offer their money under more definite conditions. This, however, does not always end the tale, as it may be found necessary after a certain point, with all surplus moneys locked up in extensions, to go into the market for further support, and obtain this by means of debentures having preferential rights.

Turn now to the case of a municipality. A definite advertisement is made for money, and a definite rate of interest is offered. The investor, on the one hand, having all the above facts in mind, and, on the other, appreciating the reliable security, is content to allow the use of his money at a lower reward than would satisfy him under less certain conditions. It is a well-known fact, which can be abundantly proved by expert opinion and experience, that municipalities are able to command capital in larger quantities and at a lower rate of interest than companies. Companies, however, are in this position: Where they can raise capital by the issue of shares they are under no obligation to pay the reward expected, or, what is equivalent, to declare dividends. This is the great difference, so far as the reward of capital is concerned, between company and municipal undertakings, but—and here is the crux of the question—no company can continuously raise the large amounts of capital necessary for developments from time to time unless it does pay a dividend at a higher rate than the rate of interest obtainable from municipalities.

Dealing now with the maintenance, or protection, of capital. Fundamentally there is no difference whatever between a company and a municipality. In both cases, if the capital invested is to be preserved, the cost of the energy sold must include such a margin as will, within the economic life of the plant, equal the original amount expended upon it, less residual value. Companies are not obliged to make this provision, while municipalities are bound systematically to create the necessary reserve. This is the very essence of the matter. Companies may, and sometimes do, act on prudent financial lines, but municipalities are legally compelled to do so. In the one case the security *may be* preserved; in the other case it *has to be* preserved. The straightforward procedure adopted by municipalities creates a strength impossible to obtain in any other way.

Capital invested in electricity supply undertakings in this country has often been poorly rewarded in the past, and as experience largely affects investors it is useless in the long run to expect to be able to obtain money unless past anticipations have been realised. Provided definite terms and security are offered, and fulfilled, money can be obtained, and there is no case on record where a municipality has failed to meet its obligations by way of interest or repayments. Difficulties encountered in offering sufficiently attractive and secure terms have been practically confined to company undertakings.

Electricity supply concerns are inherently handicapped in their capital operations, because of a very low turnover, this being generally only around 20 per cent. per annum of the total capital expenditure, and

often less than that. The margin of safety is so very fine that unless the strictest precautions are taken the investment must be unattractive, and in any case very small hope can be held out of a return such as is possible in industries more fortunately placed. Thus one is driven to the conclusion that, with an investing public aware of the facts, and demanding a return sufficiently high to compensate for the uncertainty prevailing, the whole capital requirements of public electricity supply can be better met under conditions similar to those obtaining in municipal circles than in any other way.

Supply developments in America have undoubtedly been very much more intense than in this country, but even there the same difficulties have confronted company undertakers, and attempts to overcome these have been made by inviting consumers to subscribe capital in something like proportion to their demands for supply. A measure of success has attended such schemes, but it is with surprise one learns that similar steps have been necessary in the case of a British company. The general effect on electrical investments will be adverse, for raising money in this way will be interpreted as a confession of weakness to command support in the money market. If money cannot be raised publicly, the obvious reason is that the security offered is not sufficiently sound. The logical extension of such an admission is that our important key industry cannot maintain itself.

British financial methods have evolved out of our extensive commercial experience to such a degree of soundness that throughout the world they are held in respect, and immediately prior to the unprecedented upheavals caused by the late war financial control was largely centred in England. This result had only been achieved after long and varied experience, in the course of which many propositions now put forward in newer countries as being novel were tried and found unsatisfactory. It is felt that the defects of the proposition now upheld in certain quarters as ideal must be apparent to keen business men. Every industry requires to be careful of its capital, and application of any portion to help outside concerns which are only able to utilise it to a less degree must entail a sacrifice. Assume a case where a company taking supply from a public undertaking is invited to subscribe £5,000 towards the capital commitments necessary to maintain the service. This amount will earn a turnover of, say, £1,000. If it had been retained in the consumer's business it would probably have earned many times as much, and thus have been more remuneratively employed. In the one case the maximum yield to be expected would be about 5 per cent., whereas in the other 10 per cent. or even more would have been possible; something like 5 per cent. will have been lost by the consumer. Under these circumstances he would certainly have been well advised to take advantage of the facilities offered by municipalities for obtaining abundant and cheap supplies of capital, and the position is accurately reflected in the necessity of paying 12 per cent. when money is obtained in other ways.

Load factor improvement is certainly a more profitable field in which to work, and the most successful means of dealing with the entire problem is to increase output per £ of capital expenditure, thus raising the yield or turnover and so placing the undertaking in a position to bear the additional costs necessary to obtain its new capital. The diversion of activities from the obtaining of new consumers on existing networks, or a further use of supply by present consumers, or, what is very important, from a rearrangement of the load to reduce the expensive "peaks" that render economical operation so difficult, to the more limited field of obtaining capital support by consumers cannot ultimately bring out the best results.

Super-power stations have been the subject of much adverse criticism, but the aim of centralised generation does not appear always to be thoroughly appreciated. The common test applied: "Can enough coal be saved to warrant the capital expenditure?" does not exhaust the question, as the outlook of the industry will be limited unless local generation is supplemented by large power stations erected on sites capable of meeting all demands, having regard to the ever-increasing use of electrical methods, and with the ultimate view of eliminating local generation as and when its economic value disappears. It would, of course, be absurd immediately to scrap all existing stations and replace them by centralised generation for large districts, but a careful examination of the reorganisation schemes before the Electricity Commissioners shows that this is not intended. Development of existing sites to their economic limit appears to be contemplated, with a provision for further development in the only sound way—by the selection and utilisation of suitable sites from which to meet the prospective heavy demands of the near future. Assume a group of undertakers, company and municipal, with separate power stations, the sites of which are all nearing economic saturation, and with growing loads to meet. Surely the best means of dealing with the situation is for these undertakers to combine and erect a common large station, contributing towards the capital cost in proportion to their needs. Generation efficiency would be increased, and capital cost per kilowatt reduced, in this way.

It seems rather biased to suggest that municipalities would not be prepared to enter such schemes because they might give other undertakers a chance of economising. The active support recently extended by the general body of municipal undertakers throughout the country to the Electricity (Supply) Bill now before Parliament, upon which the development of these schemes is dependent, directly contradicts any such supposition. With regard to the ratepayers' interests, these may, without any chance of mistake, be assumed directly to support the cheaper supply that would be made possible in this way.

An idea seems to be prevalent that combined schemes on Joint Electricity Authority lines may be unsuccessful because investors will not supply capital unless its expenditure is wholly under the control of men nominated by them. The facts already outlined in this article should dispel such notions, which ignore the principal aims of private investors—to obtain reward and security. The most effective way of meeting these aims is to operate on the lines which have proved so eminently successful in the case of municipalities.

HYDRO-ELECTRIC PROGRESS IN CANADA.

The Dominion Water Power Branch of the Department of the Interior, Canada, has published a concise review of hydro-electric development in Canada during 1921. The difficulties of adjudging progress during such a short period as a year are spoken of, but it is stated that an additional 300,000 h.p. of plant was installed. This has taken place in spite of the continuance of adverse industrial conditions, but the optimistic note is present in a statement of belief that the depression is gradually being raised. A comparison with the United States shows that Canadian development is greater, the 1920 figures being 280 h.p. per head in the Dominion and 93 h.p. in the United States. Hydro-electric work in Ontario has been fully covered in previous numbers of this journal, but other provinces have also gone ahead. In British Columbia the B.C. Electric Railway Company installed, during 1921, a fourth 13,200-h.p. set at the Stave Falls plant. The Wanaimo Electric Light & Power Co. placed a 200-h.p. unit in operation. Surveys and investigatory work have been carried on upon the Bridge River, where it is estimated that 360,000 h.p. is available at a distance of 130 miles from Vancouver.

In Alberta, surveys for a development of between 8,000 and 10,000 h.p. at Lake Minnewanka have proceeded. This is being developed quickly owing to the urgent need for power in Calgary.

Progress in Manitoba during the year includes the installation of two units with a total output of 13,800 h.p. at the Winnipeg municipal station: another unit of 6,900 h.p. is in course of erection, bringing the total capacity of the plant up to 67,100 h.p. A new duplicate transmission line to the city was also completed. The plant at the Du Bonnet Falls on the Winnipeg River is under active construction. The initial installation will be two units totalling 56,000 h.p., to be ultimately extended to six units with a capacity of 168,000 h.p.,

at a cost of about $10,000,000. The Manitoba Power Commission (a similar body to the Hydro-Electric Power Commission of Ontario has been active during the past year in extending its transmission system, and has now a considerable network.

The Quebec authorities have carried out a great deal of beneficial work, including the creation of storage reservoirs in several of the principal watersheds, which have proved of great assistance to the power companies of the province. The plant actually installed during 1921 amounted to 90,000 h.p., with 42,000 h.p. in process of installation. At Grand Mere the Laurentian Power Co. put in additional turbine capacity equalling 42,000 h.p., while a similar step was taken by the Shawinigan Water & Power Co., at Shawinigan Falls. The City of Sherbrooke increased the head of the St. Francis River, and added a 1,700-h.p. set, bringing its plant capacity up to 4,700 h.p. The Corporation d'Energie de Raphael started up a new installation of 3,600 h.p. on the Riviere du Sud, and the following industrial concerns also put new plant into commission:—Messrs. Price Bros. & Co., Ltd. (pulp and paper mills—17,600 h.p.); the Dominion Textile Co. (3,000 h.p., replacing an old plant); and the Lotbiniere Lumber Co. (1,680 h.p., on the Nicolet Falls). The Cedars Rapids Manufacturing and Power Co. had under way the addition of two new sets of 10,800 h.p. each, making its total installation 151,200 h.p.

In New Brunswick, the Electric Power Commission proceeded with the development of the Musquash River by the installation of plant to the extent of 11,000 h.p., for the supply of power to St. John and Moncton; contracts are being negotiated for the annual supply of 15,000,000 kWh to the former and 5,000,000 kWh to the latter. The Bathurst Lumber Co. has had under construction at Grand Falls on the Nepisiguit River a plant of 13,500 h.p. for the operation of pulp and saw mills, and the supply of power to the district; 9,000 h.p. was put into working during 1921. The Electric Power Commission has arranged to take a bulk supply from this plant, and has completed a 33,000-V transmission line, 40 miles long, for the purpose.

Under the direction of the Nova Scotia Power Commission, a plant with an ultimate capacity of 15,000 h.p. is being erected at St. Margaret's Bay, and is now ready to deliver 6,600 h.p. to Halifax when the agreement has been made.

The Yarmouth Light and Power Co. has practically completed the rebuilding of its 150-h.p. station, which was destroyed by fire. Detailed investigations have been continued for a development of 30,000 h.p. at Sheet Harbour to supply New Glasgow, Stellarton, Trenton, &c., and for two developments of 7,500 h.p. and 1,200 h.p. at Bear River.

The Dominion Water Power Branch, after careful study of the water-power laws and regulations in all parts of the world, has framed a new set of regulations for the water-powers of Western Canada, and this was published during 1921.

Prominent in the investigatory work carried out during the year was the survey of the St. Lawrence River by Messrs. Wooten & Bowden for the International Joint Commission. Three complete alternative schemes for the utilisation of the full power of the St. Lawrence were submitted. There are now 570 stream measurement stations regularly maintained on the principal streams from coast to coast, in addition to those maintained by the province of Quebec.

On the Slave and Hay Rivers, special investigations have been carried out, as a result of which a development of 300,000 h.p. on the Slave River has been outlined, and another of 30,000 h.p. has been found possible on the Hay River.

It is estimated that, but for Canada's water-power, she would have to import coal at a cost of $146,500,000 per annum. The capital invested in hydro-electric undertakings is about $534,000,000.

A later report of the Water Power Branch gives the most up-to-date statistics of available and developed water-power resources throughout the whole of the Dominion. The basis and methods of computing potential resources are most conservative; only those rapids, falls, &c., are listed whose actual existent drop or the head possible of concentration, is definitely known or well-established. The power estimates are based on the 24-hour power at 80 per cent. efficiency, and are calculated for "ordinary minimum flow" and "estimated flow for maximum development." The recorded power available throughout the Dominion under conditions of ordinary minimum flow is 18,255,000 h.p. The estimated flow for maximum development gives a figure of 32,076,000 h.p., to be depended upon for at least six months of the year. The water wheels and turbines installed only utilise 2,763,000 h.p. As it is estimated that a turbine installation of 41,700,000 could be accommodated by the existing power, it will be seen that only 6.6 per cent. of the recorded resources is being used. The 2,763,000 h.p. at present in use is distributed as follows: Central electric stations for general purposes, such as the operation of tramways, for supplying mines, electro-chemical and electro-metallurgical industries, the operation of pulp and paper mills, and for general industrial and domestic use, 2,013,000 h.p.; installed in pulp and paper mills, and used in addition to 161,000 h.p. from central stations, 476,000 h.p.; installed in other industrial establishments, 274,000 h.p. The size of the generating sets employed ranges from 10 to 60,000 h.p.; the average is 3,077 h.p. It is of interest to note that as regards central stations, privately-owned stations develop 1,449,000 h.p., as compared with 564,000 h.p. produced by publicly-owned stations.

PROTECTIVE APPARATUS FOR TURBO-GENERATORS.

Discussion at Manchester.

Mr. J. A. Kuyser read his paper on the above subject (an abstract of which appeared in our issue of May 12th) before the North-Western Centre of the Institution of Electrical Engineers on April 4th, and during the discussion that followed,

Mr. G. A. Cheetham said that the Merz-Price system undoubtedly had some disadvantages, but it had proved its efficacy in service. The figure of 100 per cent. full-load current for the setting of the relays undoubtedly referred to some very antediluvian equipment. It is possible now to give 15 per cent. of full-load quite easily without any danger of the gear tripping under overload conditions. The trouble when 100 per cent. settings had to be given on relays was due to the fact that designers had not recognised that current transformers could not be readily balanced when the transformers were working on a very low portion of the magnetisation curve, and the remedy was provided by increasing the impedance of the relay circuits, so that the transformers worked higher up the magnetisation curve. When the full-load current of a machine was low it was possible to obtain Merz-Price gear which would give better protection than self-balancing gear. Under normal conditions self-balancing gave a lower fault section than the Merz-Price gear, but within the last year or so there had been introduced an improved scheme in connection with Merz-Price apparatus, which consisted of two relays connected on the phase relays, giving a higher setting, which was susceptible to faults between phases and one other relay of low setting which was susceptible to earth faults only. It enabled designers to give Merz-Price gear protection at 7½ per cent. instead of 15 with an earthing resistance which passed full-load current with a dead earth on one phase. Again, with regard to self-balancing gear, when there was a joint in the iron circuit of the protective transformer very great care had to be taken with regard to the position of the leads. The joint, of course, was a convenience, as it enabled the transformer to be built round the cable, but it was a disadvantage and on the whole it was better to avoid the joint.

One of the principal disadvantages of self-balancing gear was that the connections had to be brought up by cable to the switch gear cubicle if protection of the whole of the cable was to be obtained. That certainly was expensive, and it was usual in such cases to use a shunt cable, or some other arrangement of that type, and put the balancing transformers at the machine terminals, and not in the switchgear cubicle. It was quite true that additional protection was given by the new mid-point protective gear (protection between turns), but two disadvantages of that scheme were the utilisation of potential transformers and that the generator terminals were not protected.

Mr. H. C. Lamb thought the paper illustrated the difference between the point of view of the designer and that of the power engineer. The designer was pre-occupied with making his design as perfect as possible and, when that was done, with introducing automatic devices which would prevent the complete destruction of the machine in case a fault did occur; but the power engineer had a third consideration, which was equally important; he must, under all circumstances, so far as possible, maintain the continuity of the supply. To avoid any interruption through the operation of some automatic gear for no proper cause the engineer fought shy of many automatic devices. That was why he liked two links in connection with the automatic cutting out of the generator field—not because he imagined that any harm would come to the generator if the field were cut off. He was reluctant, for the same reason, to make dampers on the generators automatic; there were advantages in having them operated by hand, provided that easy means were there for tripping them in case of need. No power engineer would contemplate an automatic steam connection to his generators; that might be a very good thing, but very adequate precautions would be necessary to ensure that it did not cause the breakdown of the generator.

In his list of causes of damage to h.p. windings Mr. Kuyser had omitted one, *i.e.*, mechanical faults on rotors. He agreed as to the advantages of the closed-air system, but there was a difficulty in stations which were not situated on a river side, because in summer the temperature of the cooling-tower system was too high for generator air cooling. The pressure of the water inside the cooler should be below atmosphere, because if that were not the case some day or other a leak was sure to occur, and would be itself the cause of breakdown.

Mr. Kuyser's new system of mid-point protection no doubt had something to recommend it, but it came too late in the day. In these days there should not be any faults between turns. One objection to the system was the use of potential transformers. A breakdown of the winding or the blowing of one of the protective fuses of the transformer would cause the relay to operate and cut the generator out. No power engineer would contemplate installing the system where two generators would be cut out in case of a fault on one of them only. Mr. Kuyser finished up by saying: "It is questionable

whether the complete protective system outlined above is necessary, as a fire can usually be prevented if the main field is 'killed' instantaneously." That was what they should all aim at.

Mr. G. A. Juhlin pointed out that Mr. Lamb's third point of importance to the power engineer was equally important to the designer. He might not always succeed in producing a machine which would give no trouble and, therefore, no interruption of the supply, but failure was not due to lack of endeavour. As regarded insulation, one of the big troubles had been dampness. A machine, which had been standing for the Christmas holidays, when started up broke down at approximately half voltage. The fault undoubtedly was bad sweating, and it could only be ascribed to the fact that the discharge from the machine was taken outside the station. So, while one might deprecate the use of dampers there was no doubt that they had their proper place in the complete system of protective machines; a number of operating engineers had adopted the automatic damper so as to protect the machine against fire. One source of trouble which was prevalent was the use of Empire tape which was of a very poor mechanical nature. Since the adoption of mica tape on the end windings troubles of that kind had ceased altogether. String for bracing the end connections was not of the slightest use. Mid-point protection had probably come a little too late, but there was a considerable number of small machines being installed for private installations and, in addition to that, the scheme was applicable to transformers which needed protection between turns. The only satisfactory means of obtaining quick protection of the field was by connecting the field with the generator itself.

Mr. H. A. Ratcliff said that in the mid-point protective gear described in the paper the potential transformer seemed to be the great weakness of the system, and would be quite sufficient to condemn it so far as he was concerned. Another method of protection in the case of a machine having duplicate windings was somewhat like the arrangement shown in the author's fig. 7, except that instead of two mid-point tappings and a coil bridged across them, the two ends of the windings were taken out in opposite directions through a ring transformer and given exactly similar balance to the Merz-Hunter system for cables. The function of most of these protective devices was to save time when it was a matter of burning out, and so eliminate the time lag inseparable from the human element. In other words, the gear must be more reliable than the human element, and more reliable than the plant which it had to protect. Protective systems might be overdone, and might reach a point where the continuity of the supply was imperilled.

The Chairman (Ald. W. Walker) read a communication from Mr. D. S. Paxton, who endorsed Mr. Kuyser's views regarding the shortcomings of both dry and wet air filters. Machines fitted with wet air filters invariably showed a lower insulation resistance than the other generators. Dry filters of the cloth-pocket type, on the other hand, were cumbersome and required frequent attention. A recent introduction to this country was an intermediate type of air filter, which consisted of a series of compact cells carried in an angle-iron framework which could be built into the generator foundation, or the outer wall of the building, each cell containing a large number of small thin copper-plated steel tubes or nipples, on the surface of which was a thin film of very high flash-point, highly viscous oil, which formed the cleaning medium, and extracted dirt, dust, and excessive moisture from the air; it was claimed that drastic tests had clearly demonstrated that oil would not be carried over on to the alternator windings. A closed-air system undoubtedly offered advantages where the necessary large volume of cooling water was available. It could not be altogether accepted, however, that the only dirt that could be deposited in the machine was that contained in the original volume of air in the circulating system. The system would not be hermetically sealed, and there was bound to be a certain amount of "breathing" action, in the course of which some additional dirt would doubtless find its way into the ducts. Provision for this breathing action should be made at some definite point in the air circulating system, preferably in the sides of the straightest and longest section of the air duct, and should take the form of one or two cells containing the oil film filtering medium. The cells, being placed with their faces parallel to the direction of air flow, would not cause any influx of air under normal circumstances, but would permit the air volume balance to be maintained during expansion and contraction through a regulated path which would clean the make-up air, instead of permitting it to find its way in through devious paths, carrying dirt with it. Where insufficient cooling water was available to permit the use of the closed-air system, the oil-film filter in conjunction with a system of air dampers, as recommended by the author, should give equal security against fire risks. In fact, the oil-film filter might be regarded as preferable even to the closed-air system, as with the latter there was some possibility of water leakage from the cooling coils causing moisture to be deposited on the alternator windings.

Mr. S. Ferguson explained that the paper did not pay any attention to faults which might attack a generator from the outside. A fair proportion of breakdowns occurred through surges on the cable system (which were harmless as such) but on entering the windings of the generator, due to the change in impedance causing a high voltage rise, they broke down the end turns. External reactance would take the bump instead of the machine in such cases. A simple form of protection which had not been mentioned by the author was the Ferranti-Field system, which had several advantages. There had been a tendency for machine builders to call for neutral earthing resistance to very heavy currents to oppose the normal current of the machine. Had it been fully appreciated what the shock was to the system? A neutral resistance with negative temperature coefficient, which passed a limited current at starting and gradually increased, due to the heat developed, was an advantage. There was great need for simplicity in protective gear; often some link in the protective gear failed to operate at the correct time. Personally, he was very desirous of eliminating all relays and operating directly with the fault current on to a trip coil on the oil switch, having a mechanical arrangement to effect the power reduction. The author's new scheme of protective gear seemed rather too complicated to be of value, especially as it was difficult to conceive a fault between turns which did not go to earth.

Mr. J. Frith remarked that hardly a speaker had refrained from running down potential transformers, and he coupled with them what was only one stage better, current transformers. Why should they have nine-tenths of their troubles with those appliances? Had the author thought of eliminating the oxygen from the circulating air? Nitrogen and CO_2 were cheap enough. Why not keep a stock? It would effectually prevent a fire being started in the alternator, and would overcome some of the troubles that had been mentioned.

Mr. R. Townend thought that if the machine was of very small capacity a series winding on the 'exciter was really' necessary.

Mr. E. P. Hill mentioned that he knew of trouble in an enclosed set for which the air was drawn from outside the power house, and during the cold weather it became very cold after leaving the wet filter. That caused the outside of the end belts of the turbo-alternator to drip with moisture, which was drawn along with the air into the ducts through various small openings in the joints. It was safer, therefore, to draw in the air from the engine-room until the whole machine reached a temperature high enough to prevent condensation.

Mr. J. H. Buchanan thought it his duty to say something on behalf of the makers of potential and current transformers. The maker had a certain difficulty in supplying the apparatus which he thought best; in the majority of cases much more importance was attached to an increase in the cost than to anything else. It was impossible for a manufacturer to supply the large variety of transformers that would meet every specification. The result was that he was in a way discouraged from spending money in developing designs which would appeal to comparatively few people. It was worth remembering that the best results could not always be obtained when the transformer was used both for protective gear and for working instruments; the best results were always obtained by keeping protective gear and instruments quite separate.

Mr. J. A. Kuyser, in reply to points raised during the discussion, said he had not made any extravagant claims for the mid-point protective gear; it was put forward tentatively. Whether it was necessary to protect between turns was a debatable question. It was certainly a good point to have the pressure in the cooler below atmosphere, though a small amount of leakage would, perhaps, not be disastrous if discovered in time. Another point in connection with the air cooler was that the system must be made air-tight. It had been said that mid-point protective gear came too late because there were now no faults between turns, but such faults did occur. The damping effect was rather an important point. It would be desirable to have a laminated rotor with infinite resistance in the damping circuit, and to have discharge resistance which would give the maximum voltage which it was considered the winding would stand. That would give the maximum speed one could obtain, but unfortunately that was not possible at the present time.

Gyroscope for Liners.—A test of a huge gyro-stabiliser, designed to prevent the rolling of ships, was witnessed at the Philadelphia works of the Westinghouse Electric & Manufacturing Co. recently by representatives of shipping companies. The test was declared to have been a pronounced success. It was said that by using the device passengers would be enabled to walk on the decks, regardless of rough weather. The stabiliser, which weighs 120 tons, is to be installed in the Shipping Board steamer *Hawkeye State*, plying between Baltimore and Honolulu. It is said to be the largest ever constructed and the first one to be placed in a large passenger vessel. The gyro-stabiliser attained during the test an overspeed of 10 per cent., or 880 revolutions a minute. The action is controlled by small gyroscopes along the sides of the vessel. These register the direction of the roll and automatically start the big stabiliser wheel revolving in the direction necessary to counteract the motion of the ship.—*Reuter's Trade Service* (Philadelphia, U.S.A.).

THE INTERNATIONAL TRANSPORT CONGRESS, LONDON.

While the numerous forms of transport received a great deal of attention at the Congress recently held by the Institute of Transport, the scope of the proceedings was enlarged to bring in a number of other matters which had a bearing, in one way or another, upon the main question. For instance, on the first day (May 17th) Capt. M. Riall Sankey, C.B., C.B.E., lectured on "Wireless as an Aid to Transport," and dealt with his subject in a very broad manner. He reviewed the many uses to which "wireless" is put for marine purposes, such as communication, direction-finding, &c. In this connection he displayed a slide showing one of the communication charts issued by the Marconi Co. each month, on which the sailings of various large transatlantic boats were indicated. By what was perhaps merely coincidence the chart shown was dated "April, 1912," and the first and only voyage of the *Titanic* was marked upon it. By means of other lantern slides, Capt. Sankey gave his audience a good understanding of the nature of the wireless equipment carried by ocean-going vessels. The usefulness of direction-finding was illustrated by the case of the Norwegian steamer *Ontaneda*, which was recently driven out of its course and disabled by a gale. The captain endeavoured by means of "wireless" to give his direction, found by dead reckoning. His message was picked up by the British steamer *Fanad Head*, which discovered, by means of its Marconi direction finder, that the *Ontaneda's* true position was 90 miles from that calculated by the captain. In the meantime several vessels went to the indicated position and could find no trace of the *Ontaneda*. The speaker made mention of the recently-invented wireless "beam," for warning ships of approaching danger in fogs or rough weather. Reference to work in this direction was made by Mr. C. S. Franklin in the paper on "Short-wave Directional Wireless Telegraphy," recently read before the Institution of Electrical Engineers. The use of "wireless" in aircraft communications was then touched upon, and it was shown that direction-giving was a most essential requirement in cross-Channel flights, where fogs were of such frequent occurrence. The application of wireless telegraphy and telephony to road transport was a question of a widely different nature. Capt. Sankey thought that when organised traffic systems, owned by responsible authorities came into being, the method might be employed to give instructions to drivers from a central position. Telephony would, in this case, be preferable to telegraphy, as it would not be necessary for drivers to learn the Morse code. Both transmission and reception were used at present in the transport section of the Army; the transmitter was capable of being used for both telegraphy and telephony. The Marconi 500-W equipment for this purpose was a good example of its kind. With 30-ft. aerial masts, the guaranteed range for telephony was 70 miles, and for telegraphy 200 miles. There appeared, however, to be little scope for wireless in land transport as compared with its use at sea and in the air, and probably the Postmaster-General would show resentment at its extended use for land transport purposes. In conclusion, Capt. Sankey briefly mentioned American experiments in the use of wireless on trains, of which little definite information was available. In the short discussion which ensued, Mr. Roger Smith disclosed some details of experiments made on the Great Western Railway in 1919, by the military authorities. A transmitting set was fixed at Woolwich and a 120-W c.w. receiving set was installed in one coach of a train running from Paddington to Bristol. Using a wave-length of 1,150 m., good telegraphic signals were received over the whole of the journey. The receiving aerial was on a 2 ft. 6 in. square frame. Some trouble was experienced from R.A.F. signals which employed approximately the same wave length, and atmospherics also made their presence felt. In tunnels and cuttings and over bridges there were slight interruptions. Subsequently, similar experiments were made on the Paddington-Fishguard route, a length of 260 miles, and good results were obtained. Mr. Smith emphasised the fact that the substitution of wireless for line signalling was out of the question; its only use would be for commercial purposes or amusement. Mr. Nash warned the audience that the wave-lengths remaining available were rapidly diminishing, and said that if the use of wireless for land transport was contemplated efforts should be made to reserve wave-lengths. This speaker also suggested the use of "wired wireless," but Capt. Sankey said that this was outside the scope of the paper—not being "wireless" in the correct sense of the word. Col. Cortez-Leigh added to Mr. Smith's information some particulars of experiments in wireless telephony made by the Marconi Co. on the L. & N.W. Railway in 1920. In this case a transmitting set employing 50-ft. aerial masts was mounted on the top of Euston station and a similar installation was erected at Crewe, 158 miles away. At times speech was perfect, and Col. Cortez-Leigh thought that the system would be of use in the event of the interruption by storms of ordinary means of communication. It would certainly not supplant the present system of signalling.

On the same morning more definite proposals were put forward by Col. C. H. Bressey, C.B.E., for the improvement of highway design to meet the altering circumstances brought about by the ever-growing number of mechanically-propelled vehicles used for transportation purposes. The horse is rapidly disappearing from our roads, and it is certain that the roads which were good enough for horses will never be able to "stand up" to modern means of transport. Col. Bressey gave some particulars of the great amount of work being carried out upon roads all over the country, making special reference to those in the London area. The speaker expressed sympathy with those local authorities who had to bear the increased maintenance costs engendered by growing traffic which did not benefit them, but did not mention the burden carried by tramway authorities, which pay for the repair of damage done by other people. Lord Montague of Beaulieu said that the construction of suitable roads was a matter of finance. Given the necessary funds they had the engineers to carry out the work. The money should certainly be granted, for the prosperity of the nation largely depended upon its roads.

Sir Cyril Kirkpatrick read a paper on "Recent Improvements in Transport Facilities in the Port of London," in which he drew attention to the numerous ways in which the handling of goods at the port had been facilitated. The magnitude of the Authority's work is not generally realised. The speaker showed that there was usually in store 20,000 tons of meat, 84,000 tons of wool, 36,500 tons of tobacco, 300,000 tons of timber, 15,000 tons of tea, as well as huge quantities of other goods. The various docks and wharves were dealt with, and mention was made of the George V Dock, with its excellent electric lighting, the electrically-operated bascule bridge, bearing a public road over a lock, and its electric cranes. The speaker described the electrical pumping plant for maintaining the water level between the George V, Royal Albert, and Victoria Docks, comprising 245 acres of water area. There were three 70-in. diameter centrifugal pumps, driven by 6,000-V a.c. motors. These pumped about 16¾ million gallons per hour for the three hours preceding and the three hours following high-water. An interesting feature of the plant was a long-distance electrical tide gauge, by which a combined diagram was drawn of the level of the water in the docks and the river simultaneously. The dry dock at the George V Dock, 750 ft. long, 100 ft. wide, and 35 ft. deep, could be emptied by its electrically-driven centrifugal pumps in three hours. As a rule the cranes used in the Port were 3-ton electric cranes, with a radius of 60 ft., and equipped with luffing arms. To overcome the difficulty of obtaining an increased outreach without swinging the load through a larger radius, two "T"-headed cranes had been built experimentally at the George V Dock. These cranes travelled just as the others, but the "T"-head revolved in a complete circle, and on the top was a 3-ton travelling crane of small radius. It was anticipated that a great deal of time would be saved by this means. Electric trucks were in extensive use throughout the docks.

On May 18th Mr. Neville Chamberlain, M.P., read a paper on "Inland Water Transport: A Practical Policy," in which he advocated central management and control; properly-equipped terminal facilities, with ample storage space; and regular services. He suggested the grouping of the navigable rivers and canals into seven sections, each controlled by a trust.

Sir John Thornycroft, in a paper on "The Future Design of Road Vehicles for Passenger and Goods Services," said that he did not consider that the railless trolley vehicle would ever be extensively used for the carriage of goods, but it would probably have considerable scope for passenger work. The only satisfactory substitute for gear-box transmission was the petrol-electric system.

A paper by Prof. J. Carlier, of Liége University, upon "Foreign Railway Practice," was read on May 19th. As the chairman (Sir I. Thomas Williams) said, the title was a little vague, because the paper was virtually a review of attempts to find a more efficient haulage than that provided by the modern steam locomotive. The paper opened with a comparison of costs of operation and the capital charges as between steam and electric working. The statements made agreed very closely with those put forward by Sir Vincent L. Raven in his recent paper on main-line railway electrification, putting the coal saving by electrification at from 50 to 66 per cent. under the ordinary conditions obtaining in Europe. The Chicago, Milwaukee and St. Paul Railway was given a great deal of attention, but Mr. Roger T. Smith, in the subsequent discussion, said that this was hardly typical, as not only was hydro-electric energy employed, but the conditions were vastly different to European conditions. The author thought that only those countries with abundant water-power could carry out immediate electrification. Others not so situated would be advised to wait until it was seen if the present steam system could be improved. Although electrification was eminently satisfactory as regarded efficiency and economy in working, it involved heavy capital charges. In

this connection, however, Mr. Roger Smith suggested following the present-day policy of British railways in replacing locomotives out of revenue. It was admitted, he said, that an electric locomotive could do the work of two steam locomotives, and it should be possible to purchase one electric engine for each pair of steam engines relegated to the scrap-heap; money would actually be saved in this way to pay in part for the electrification of the permanent way. The paper went on to say that there might be expected a keen competition in the future between electric traction and other forms of traction, including the application of the Diesel engine to locomotives, in which direction many experiments had been made. Then there were possibilities in steam-electric or petrol-electric systems; previous developments of this nature were dealt with in the paper, starting from the "Heilmann" system, tried in France in 1898. This was found to be uneconomical owing to the use of a non-condensing engine. An improved form of the "Heilmann" locomotive, the "Reid-Ramsay," was tried in England in 1908, but the same deficiency barred its adoption. The Ramsay Condensing Locomotive Co. had recently put under test a turbo-electric locomotive, which seemed full of promise. This appeared to effect a fuel economy of 50 per cent. as compared with the ordinary steam locomotive. The ordinary turbine-driven locomotive involved the problem of satisfactory speed control, but the system was certainly simpler than the "generating station on wheels" system, which badly impressed the locomotive engineer owing to its complication. The author expressed the opinion that the substitution f an internal-combustion engine for the steam turbine would give more satisfactory results, and instanced examples of this type of locomotive, such as the "Diesel-Sulzer," the "Strang," the "Pieper," and others. He suggested that if such a system were employed it would be advisable to use a third rail, by means of which the surplus energy of one locomotive might be used upon another. An alternative to this was the employment of accumulator batteries on the engines. In conclusion, the opinion was put forward that electrification would be seriously handicapped by the improvement of independent forms of traction indicated.

The Chairman said that he thought that, except in the most exceptional circumstances, electric traction was not a paying "proposition." An American railway statistician had told him that the Chicago, Milwaukee and St. Paul railway was one of the most expensive in the United States owing to its heavy capital charges. He had been impressed by experiments in petrol-electric traction, which he had seen in Hungary.

Following this paper, Col. J. W. Pringle, C.B., read a paper on "'Safety' in Railway Operation," in which he analysed the statistics of railway accidents. He found that about 20 per cent. of serious accidents were due to defects in equipment, while 80 per cent. were attributable to the failure of the "human element." About 25 per cent. of the human errors were on the part of signalmen; the only effective remedy against these was track-circuiting, which had the advantages that, for normal working, there was no occasion to provide signalmen with a means of release for the electrical control (as in the case of token working); and that the presence of any vehicles left behind in the protected area, owing to trains being divided or being forgotten in shunting operations, was continuously detected. Automatic train control would have obviated at least 33 per cent. of the 200 serious accidents analysed by the author; the advantages in the direction of safety obtained by means of this, continuous track-circuiting, and automatic signalling were evidenced by the experience obtained on the London "Underground" system. There had been cases, however, to prove that there was still room for improvement upon the best-equipped lines.

Mr. Selway said that he did not think automatic train control would be received with favour generally owing to its cost and offsetting disadvantages. An endeavour should be made to improve the human element by proper training and supervision.

Mr. J. P. Thomas, of the "Underground" railways, said that a number of the accidents classed as "reasonably preventable" were due to faulty material, and there was a need for better testing arrangements. He said that detonator fog signals had been supplanted on the "Underground" by powerful electric lamps in connection with the track circuit system. By means of automatic signalling it was possible to cut off the power in a section from 15 to 20 seconds, and this was being reduced to 10 seconds.

In the evening, at the Royal Society of Arts, Mr. F. V. Russell, C.B.E., lectured on "The operation of heavy suburban passenger services on a steam railway, with particular reference to density of service, terminal and other facilities."

Saturday, May 20th, was devoted to visits, which included an inspection of the L. & N.W. Railway power station at Stonebridge Park.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Versatile Machine Tool.

A New York firm, the Triplex Machine Tool Corporation, has designed a bench-type machine tool which can be used for a number of purposes. This consists of a heavy slotted bed-plate, upon which is mounted a standard or column. On the latter a swinging carriage, capable of vertical adjustment, is fitted. The vertical movement of this carriage is made by means of a substantial screw. Upon the top of the standard is a quadrant, marked off in half-degrees, upon which is mounted the headstock. The spindle is driven through gears by a motor mounted upon the machine; this permits the head to be fixed at any angle upon the quadrant. There are

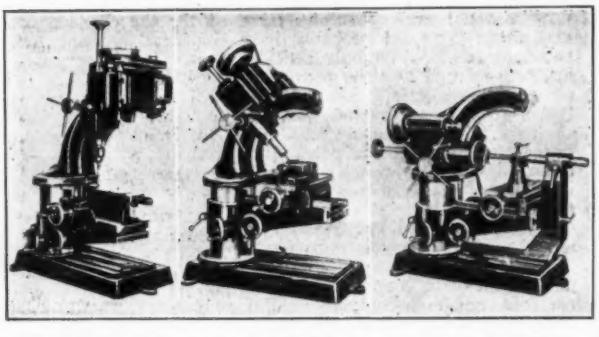

Fig. 1.—In use as a Drill. Fig. 2.—End Milling. Fig. 3.—Adapted for Turning.

The "Triplex" Machine Tool.

six spindle speeds, ranging from 90 to 1,150 r.p.m. Fig. 1 shows the machine adapted for drilling. In fig. 2 end-milling is being done, the work being fixed on a slide-rest running in the slots in the carriage. Fig. 3 shows the "Triplex" machine in use as a lathe; in this case a special tail-stock is employed. Screw-cutting can also be carried out by the machine. The work is held in a chuck or spring collett, and while the spindle is revolving a handle holding a nut segment is placed in contact with a master screw, so that the spindle is caused to feed forward, while the cutting tool remains stationary. At the end of the thread cut the nut segment is automatically thrown out. Internal threading can be performed in the same way.

We are indebted to the *Scientific American* for the illustrations and particulars of this machine.

The "Partridge" Pressure Detector.

The safety of power station operators is a prime consideration in the work of electricity supply, and many methods and means are in use to ensure the immunity of employés from shock. The device described below is not actually a new one, as the London Electric Supply Corporation, Ltd., has employed it for the past 12 years, but we do not think it is very well known outside the Corporation's system. This pressure detector, which was devised by Mr. G. W. Partridge to give both visible and audible evidence of danger, consists of an air condenser with suitable holding arrangements and a sparking point. The condenser is formed by a copper cylinder mounted upon a steel rod; one end of the latter forms the sparking point, while the other is attached to an ebonite rod recessed into the handle. Surrounding the cylinder is a cylindrical case of thick micanite, the top and bottom of this being formed by wood bushes. The type described is suitable for detecting pressures up to 11,000 V. Above this pressure, up to 60,000 V, a special double insulating shield is fitted between the micanite cylinder and the handle; for the higher pressures additional safety is ensured by using a long bamboo wand in place of the handle.

When it is desired to ascertain if current-carrying parts are "alive," the steel point of the detector is placed on a bare part of the circuit, and, if the circuit is subject to an electrical pressure, a static spark will be drawn when the point is removed. Where gear is totally enclosed, a small aperture can be cut in the insulation of one of the connecting cables for testing purposes.

The efficiency of the device was recently demonstrated to us at the works of the Westminster Engineering Co., Ltd., Victoria Road, Willesden Junction, N.W.10, this company having taken up the manufacture and sale of the detector. It

was shown that sufficient audible and visible indication of a pressure as low as 2,000 V could be obtained; it will be understood, of course, that the detector is only for use on high and extra-high pressure systems. The apparatus has been tested up to 70,000 V. A noisy discharge can be obtained across a gap of 3/16 in. with 2,000 V. and up to 1¼ in. with 7,000 V. Special regulations for its use have already been drawn up by

Fig. 4.—The "Partridge" Pressure Detector.

the London E. S. Corporation, and these are to be issued with each detector sold.

It will be seen that owing to its simple and strong construction and absence of moving parts, the detector cannot get out of order.

The illustration (fig. 4) shows the e.h.p. detector with bamboo rod and two views of the high-pressure type with and without a protector over the steel point.

The Langmuir Condensation Pump.

An early form of the Langmuir condensation pump was described in our issue of January 12th, 1917, but an improved form is now being manufactured at Rugby by the British Thomson-Houston Co., Ltd., which is the owner of the English patent rights. The Langmuir pump has been designed to produce very high vacua, and is of special value in connection with the manufacture of electric lamps and for research work. By its aid pressures lower than 10.5 bars have been produced and measured, and a speed of 3,000/4,000 c.c. per second is obtained under normal working conditions. The action of the pump briefly is as follows: The mercury M in the base of the pump is heated by a gas burner G, and the vapour which is given off impinges on the baffle-plate at the top of the heating chamber. This baffle-

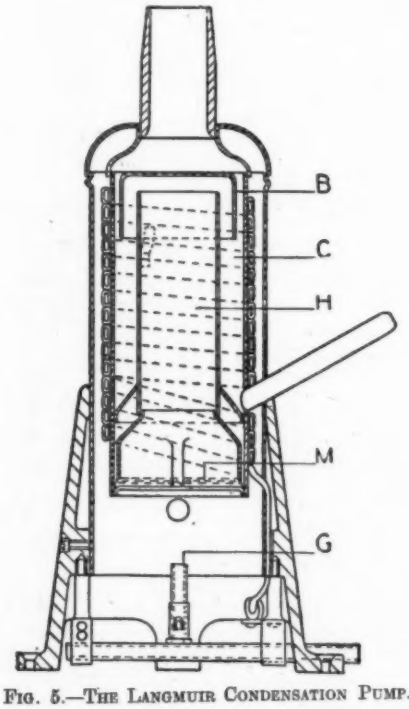

Fig. 5.—The Langmuir Condensation Pump.

plate deflects the mercury vapour downwards and outwards into the water-cooled condensation chamber C, where it mixes with the gas to be removed. This gas is thus carried downwards by the mercury vapour until the vapour condenses, when the condensed mercury flows down the walls of the chamber and returns to the base of the heating chamber, while the gas is carried to the atmosphere by means of an auxiliary pump. The proper amount of mercury for each pump is 626 grammes, and is introduced by pouring it through the vacuum port at the top of the pump (see fig. 5). The rate of water flow through the condenser should be about 1,000 c.c. per minute. In some cases the presence of mercury vapour in the vessel being exhausted may be detrimental, and this may be avoided by putting a trap (cooled by solid carbon dioxide or liquid air) between the pump and the vessel.

The auxiliary pump is connected to the small vacuum port in the side of the condensation pump, and should be capable of producing a vacuum of 0.1 mm. of mercury. The presence of a very little oil or dirt in the inner chamber will make the pump ineffective.

THE JUNIOR INSTITUTION OF ENGINEERS.

Annual Dinner.

On May 18th the thirty-eighth annual dinner of this Institution was held at the Monico Restaurant. The President (Mr. C. H. Wordingham, C.B.E.) occupied the chair, and he was supported by a distinguished company, which included Dr. W. H. Eccles, Prof. E. G. Coker, Prof. H. J. Spooner, Dr. H. S. Hele-Shaw, Mr. B. Gueritte, Mr. W. B. Worthington, Mr. Twelvetrees, and others.

After an excellent *menu*, and the toast of "The King," Dr. Hele-Shaw (president of the Institution of Mechanical Engineers) rose to propose the toast of "The Institution." The speaker expressed his pride in having been an honorary member of the Institution for thirty years, and said that the chief characteristic of the society was the enthusiastic way in which it was supported by its members. He made special reference to the short papers presented to the Institution, which were excellent, and so much harder to write than long ones. Although many "Juniors" had risen to positions of great importance, they always retained their pride in the Institution. The Journal was an excellent production, which interested him more than any similar publication—he *had* to read the journal of his own Institution. He congratulated the members upon their Chairman (Mr. E. C. West); his knowledge of refrigeration was of great value in imparting coolness to the Council's deliberations.

Mr. West, in reply, outlined the activities of the Institution, which now had nine local sections, including two abroad, and nearly 2,000 members. Many papers were read and discussed, and numerous visits were paid to works, &c., but the social side was not neglected. The Institution had a number of awards in its gift, including gold and silver medals, a silver medal at each of the local sections, the "Vickers" prize, &c. The fourth quadrennial Gustave Canet Medal was being awarded to Sir Eric Geddes, G.C.B., &c., who was to deliver a lecture on "The Railway Act of 1920" on June 1st. The engineers' register had been of service to members in obtaining employment, but, unfortunately, to-day the applications exceeded the vacancies; he asked for assistance in this direction. In the future they hoped to still further increase the membership and establish other local centres.

Dr. W. H. Eccles, F.R.S., then proposed the toast of "Electrical Engineering." He said that he wondered why this particular branch of engineering had been singled out, but upon reflection came to the conclusion that it was a compliment to the President of the "Juniors," Mr. Wordingham. Electrical engineering was a youthful science, and it demanded more from its votaries than any other branch, and new offshoots were born every day. Wireless telegraphy, a very recent invention, now had a literature which probably outweighed that of all the older sciences combined. The number of "wireless" patents ran into thousands. Still, electrical engineering was not yet perfect—indeed, his father used to say: "If you can do a thing mechanically don't do it electrically." However, the art had a wonderful future. Referring to the President, Dr. Eccles said that Mr. Wordingham had been president of the Institution of Electrical Engineers during some remarkable years, but he had made his presence felt, and put the Council to work on numerous activities and improvements. Mr. Wordingham was a "human turbo-generator," full of work and energy.

Mr. Wordingham, in responding, said that if electrical engineering was a youthful science there could not be a more appropriate toast at a "Junior" dinner. There was, however, hardly a branch of engineering into which electricity did not enter. The progress of the industry depended upon the energy of the men in it, and they in turn depended upon sound training and principles. A general training was essential, but after that specialisation should follow; this, however, should not prevent a broad outlook upon general developments. Often developments in one industry were of great importance to other industries. In studying general developments good abstracts were essential. At the present time these were too widely distributed and often duplicated. Each Institution journal published its proceedings, and the technical papers printed a mass of information. What was required was proper co-ordination, and he suggested the compilation of a permanent record of all proceedings of importance, if possible in a universal language. Information of an ephemeral or temporary nature could be separately published by the Institutions. In the business of electricity supply more attention was now being paid to economy in

the boiler-house. He thought that hitherto too much had been made of *generating* energy cheaply, and not enough of *delivering* it cheaply. Cheap electricity was only to be provided by means of a proper tariff—such as that outlined some years ago by Dr. John Hopkinson. In conclusion, the speaker said that his only regret at being president of the Junior Institution of Engineers was that he had not the opportunity of doing a great deal for its members.

Prof. E. G. Coker, in proposing the health of the guests, expressed his pleasure in seeing so many presidents of technical institutions present.

Mr. W. B. Worthington (President of the Institution of Civil Engineers) responded, and said that, after all, every branch of engineering was civil engineering; his own institution kept an open field for all members of the profession, and on its Council were to be found mechanical and electrical engineers, naval architects, and representatives of other branches.

Mr. H. V. Pointon (Vice-chairman) proposed the toast of "The President." He said that Mr. Wordingham had admirably carried on the traditions of a long line of eminent men who had occupied that position.

Mr. Wordingham briefly acknowledged the toast.

During the evening musical items were rendered by Messrs. Ernest José and Ben Lawes, and Miss Ida Norton.

THE USE OF LIGHT IN HOSPITALS.

A discussion on the above subject took place before a joint meeting of the Royal Society of Medicine and the Illuminating Engineering Society on April 27th. Mr. John Darch, who read the introductory paper, attached special importance to the avoidance of glare, which was unpleasant to doctors and nurses, and might occasion real distress to the sick. The desired quiet and pleasing conditions of illumination could best by obtained by moderate general lighting, supplemented by local lights. Indirect lighting, or lamps equipped with ring-screens of coloured china or silk, to conceal the lamps, could be used. The local lights for patients should give 3 ft.-candles on the book, and should be placed, not at the centre of the bed-head, as is usual, but about 15 in. to the left. Decoration of the ward was also an important factor; ceilings and friezes should be white, the walls of a quiet and restful colour of medium strength, and the dado dark. Glossy and polished surfaces, liable to give inconvenient reflections of light sources, should preferably be avoided. Turning next to the operating theatre, Mr. Darch remarked that existing lighting conditions were often incomplete, and imperfections were confessed by the frequent use of hand-lamps. He had seen fittings over the operating table thickly covered with dust—a condition undesirable in view of the scrupulous care regarded as necessary to secure cleanliness in the theatre. Ideal lighting conditions should resemble those obtained from a clouded white sky, and fittings should preferably not be fixed immediately over the table. Among other requirements were included an exceptionally high illumination of not less than 25 foot-candles, an arrangement which avoided inconvenient shadows from the hands or head of the operating surgeon (*i.e.*, good diffusion of light), a colour of light which approached white as nearly as possible in view of the fact that correct colour-estimates formed an important element in some operations; and no exposed lights within the field of vision. Mr. Darch described and illustrated a number of special contrivances for the lighting of operating tables, including the Seidentopf system, where a powerful beam from outside the theatre was directed and converged from different directions on the table by a system of mirrors. The author also illustrated a simpler arrangement for lighting from a series of gasfilled lamps placed outside the actual room; alternatively, four to six projector tubes, each containing a 60-W gasfilled lamp with parabolic reflector, might be mounted on adjustable brackets attached to walls and cornices and converged on the table. In the final section of his paper Mr. Darch pointed out the need for emergency lighting. Lamps should be arranged on two separate circuits, and possibly a few lamps fed from an accumulator kept as an ultimate reserve. The question had arisen whether "artificial daylight" could be used in cases where the correct appearance of colours was desired. He thought, however, that the units at present available did not give a sufficiently powerful light, and in design were not well adapted for use in an operating theatre. Special consideration should be paid to the lighting of dispensaries in view of the fact that operations of minute accuracy had often to be carried out at high speed, and mistakes might have serious consequences.

In the ensuing discussion several surgeons and ophthalmologists took part. It was agreed that good diffusion of light was of great importance, but that the problems had not yet been completely solved. Lamps used for inspection purposes presented interesting optical problems. It was desired in examining patients to obtain a brightly and evenly illuminated area, free from striations. Some compact lamps of this nature, using lamps with special filaments in conjunction with suitable lenses, were shown by Mr. J. B. Reiner. The difficulty was to obtain a lamp which would give the desired conditions of illumination and yet could be utilised at the ordinary supply voltage. Mr. Conrad Beck contributed a discussion of the requirements met with in lighting microscopes. Here the conditions were very varied, according to the nature of the work and the degree of resolution demanded from the microscope. In some cases a very intense illumination was needed, in others precautions had to be taken to prevent the illumination of the field becoming too dazzling. Mr. Beck favoured the use of lamps with special compact filaments (or "Pointolite" arc-incandescent lamps) giving a confined beam of light. In some forms of work colour-filters which absorbed a great deal of light were necessary. Generally speaking, therefore, it should be possible to obtain a very high illumination, to limit the area illuminated if desired, and to moderate the intensity by means of an adjustable wedge of dark neutral glasses. If the highest possible resolution, combined with a colour agreeable to the eye was desired, monochromatic green light should be used. A diagram illustrating a new form of lamp for use in operating theatres was shown by Mr. A. Wilson. A single incandescent lamp was placed inside a special dioptric lens of the lighthouse type, over which was a large hood carrying radial mirrors, by which the light was concentrated on the operating table. Some forms of semi-indirect units suitable for use in hospitals were exhibited by Mr. J. W. Jones, and Mr. J. W. Elliott showed some "Fullolite" lamps, with opal glass bulbs, which, in the smaller sizes, seemed well-adapted to ward lighting. Mr. Elliott also exhibited a form of lamp containing both a large and a small filament within the same bulb either of which could be put into operation by manipulating a switch, thus giving either normal lighting or a diminished illumination.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR APRIL, 1922.

The April returns of electrical exports show a falling off in values of £70,000 as compared with March, but some allowance must be made for the Easter holidays; the electrical export figures for the month totalled £1,044,580 in comparison with those for March of £1,114,586. Lower values were recorded in all sections of electrical exports, but especially in those for electrical goods, insulated wire, electrical machinery, and telegraph and telephone apparatus.

Electrical imports for April totalled £169,497, a decrease of nearly £83,000 as compared with the previous month, the principal reduction being in the import section of electrical machinery of £67,000. Re-exports of electrical goods and machinery at £36,520 were nearly £17,000 up on the previous month's figures, the increase being due to a re-export of a large quantity of glow lamps.

Values of Electrical Exports and Imports for April, 1922.

	Exports.	Imports.	Re-Exports.
	£	£	£
Electrical goods and apparatus (unenumerated)	82,146	42,000	4,041
Insulated wire	133,498	20,468	16
Glow lamps	39,178	10,435	25,398
Arc lamps and parts	955	1,398	—
Batteries and accumulators ...	41,990	6,233	5
Meters and instruments ...	28,547	4,683	1,176
Carbons	2,850	1,609	—
Electrical Machinery—			
Railway and tramway motors...	5,098	—	—
Other motors and generators ...	202,263	—	—
Switchboards (not telegraph or telephone)	13,185	140	—
Electrical machinery (unenumerated)	243,123	68,967	2,658
Telegraph and Telephone Cable and Material—			
Telegraph and telephone wire and cable (not submarine) ...	61,813	1,241	35
Submarine telegraph and telephone cable	23,020	—	—
Telegraph and telephone instruments and apparatus ...	166,909	12,323	3,191
Totals	£1,044,580	169,497	36,520

E.D.A. Activities.—The British Electrical Development Association has recently issued a supplement to its booklet on "Press Advertising for Electricity Supply Authorities and Contractors." This contains several suggestions for advertisements suitable for insertion in local papers. These are remarkable for their simplicity and the illustration with which each is provided ensures the attraction of the reader's attention. Copies of this publication can be obtained, post free, from the Association, 15, Savoy Street, W.C.2.

PARLIAMENTARY NOTES.

(From our Special Reporter.)

Special Orders.—On the motion of Mr. A. Neal, the House of Commons approved last week a number of Special Orders made by the Electricity Commissioners under the Electricity (Supply) Acts, 1882 to 1919, and confirmed by the Minister of Transport under the Electricity (Supply) Act, 1919, relating to supply in various areas. Similar Orders were approved in the House of Lords.

"Key Industries" Act.—During a debate in the House of Lords on a motion to repeal the Safeguarding of Industries Act, which imposes a duty on certain imported goods so as to protect "key" industries, Lord Beauchamp said that there were remarkable instances of delays and interferences at the docks. There was one consignment of electric lamps in which the tungsten was dutiable. The man who went to the docks to arrange for the clearance was kept there nearly the whole day. He paid 5s. clearance, and had to leave a deposit of £1. The duty was fixed at 1d.!

The motion to repeal the Act was rejected by 36 votes to 34.

"Key Industries" Duty.—Sir R. Horne, Chancellor of the Exchequer, informed Dr. Murray that the duty paid under the Safeguarding of Industries Act for the six months ending March 31st was as follows: on electrical goods and apparatus, electrical instruments (other than telegraphic and telephonic), (1) commercial (including ammeters, voltmeters, &c.), £946; (2) house service meters, £31; (3) scientific, £211; on electro-medical apparatus, X-ray tubes, wireless valves, vacuum tubes, and X-ray apparatus, £5,555.

Electric Lamps in Coal Mines.—In the course of a discussion in the House of Commons on the vote for the Ministry of Mines, Mr. Armitage, the Coalition Liberal Member for Central Leeds, dealt with the question of miners' nystagmus, and said that attention should be drawn to the facts, which must be known at the Ministry, with regard to pits where electric lamps instead of oil lamps were used. In a pit which he had to deal with, in 1912, there were about 2,400 men employed, and the nystagmus cases were eleven. The oil lamps were taken out after that year, and while the number of men employed had gone steadily up to 3,000, the nystagmus cases had gone down to three. He attributed that, to a very large extent, to the introduction of electric lamps as against oil lamps.

Mr. R. McLaren, a Scottish member, said that the Secretary for Mines ought to find out some means by which the miner might test the condition of the atmosphere in which he worked.

The Severn River Scheme.—Mr. Mills asked if any further consideration had been given to the scheme prepared by Sir Eric Geddes for the utilisation of the waters of the Severn river for the generation of electrical power; and whether, in view of the widespread unemployment and the possibilities of economy of costs in this scheme, the Government was prepared to sanction its construction.

Mr. Neal (Parliamentary Secretary to the Ministry of Transport) said he would remind the hon. member that the Water Power Resources Committee considered the subject of tidal power, and expressed the view that the technical information available with regard to the possibility of utilising the tides in the Severn for the generation of power was not sufficiently precise to enable it to express a final opinion. The Committee recommended that a Technical Commission should be set up by the Board of Trade in consultation with the Ministry of Transport to investigate the possibility from a commercial standpoint, with special reference to the Severn estuary. Owing to the financial position and the necessity for drastically curtailing the expenditure of Government departments, it had not been practicable to set up the proposed commission.

The Grampian Scheme.—Mr. Briggs asked the Chancellor of the Exchequer if he was aware that when the Grampian Electricity Supply Bill was before the Select Committee it was definitely stated in evidence that if the promoters obtained a State guarantee of their debenture issue it was their intention to refer to this in their prospectus; and would he guard the public from being misled as to the form of the State guarantee?

Sir R. Horne replied that if a guarantee was given under the Trade Facilities Act the Advisory Committee appointed under that Act would scrutinise the prospectus, and its approval would have to be obtained before the prospectus was issued, so that there was no danger of the public being misled as to the form of the State guarantee.

On May 23rd, the Report stage was reached in the House of Commons. A motion for the rejection of the Bill, by Mr. Briggs, was rejected, and the Bill ordered for third reading.

Wireless Broadcasting.—Mr. Pike Pease informed Lieut.-Col. A. Murray that the conditions under which licences for wireless broadcasting would be granted had been the subject of a conference with the interests concerned. The Postmaster-General would take an opportunity of making a statement as soon as the conditions were settled.

Ayr Electricity Bill.—After another week before the Select Committee of the House of Lords, this Bill has now been passed for third reading, subject to the minimum average flow of water in the river Doon being 8,000,000 gallons a day instead of the 6,000,000 gallons which the promoters were prepared to concede.

P.O. (Pneumatic Tubes Acquisition) Bill.—On Monday, in the House of Commons the Postmaster-General moved the second reading of the Bill, which ratifies an agreement come to between the Post Office and the Pneumatic Despatch Co., which laid, forty or fifty years ago, a tube between the General Post Office and Euston by way of Holborn and Tottenham Court Road. For some thirty years, he said, the tube had not been used for the purpose for which it was intended. In carrying out underground works some local authorities, including the London County Council, had cut into the tube. The Post Office would in no way interfere with work that had been done by any of these local authorities, but steps would be taken to divert the Post Office cables round such work. By using this derelict tube to carry telephone cables a saving of £40,000 would be effected, and the intolerable nuisance of breaking up busy thoroughfares would be obviated. The Bill was read a second time and was referred to a Select Committee.

Rural Telephones.—According to *The Times*, Mr. Hurd asked the Postmaster-General whether, in view of the decision to spend £9,500,000 this year upon telephone developments, he would consult authoritative agricultural opinion, through such a body as the National Farmers' Union, as to the best means of increasing the use of the telephone in rural areas. Mr. Kellaway said he was prepared to consider any concrete proposals on the subject. He had decided to appoint a representative of all interests concerned in agriculture.

MARKETS FOR SMALL POWER SETS.

After describing certain types of small electric power sets suitable for oversea use, *Commerce Reports* remarks that there would seem to be a fair field for small water-wheel driven sets in some countries. In Ceylon, for instance, very many plantations have small streams flowing through them that are readily available for power development; and in a great many cases mechanical-drive water wheels are already in service. These now often have a generator belted to the line shaft; but there is still a wide field for water-wheel driven sets in small capacities, which may be offered to large estates by local representatives, ready for installation without complicated erection problems.

As naturally expected, small electric lighting sets find their most ready markets where central-station service is least developed and where there are large plantations and estates. Among such countries are India, Ceylon, Mexico, parts of Central and South America, Java, Malaysia, South Africa, East Africa, and to some extent Indo-China and China. Other countries are by no means excluded as possible markets, but these are suggested as offering most favourable prospects under normal conditions. At present the inactivity in such products as rubber, jute, tea, coffee, and sugar has severely affected the buying power of the better fields for small lighting plants, but manufacturers will find it well worth while to arrange now for the necessary selling connections. General machinery import houses and electrical dealers in foreign countries are commonly the channels through which small lighting sets are marketed.

According to the United States Consul at Aden, farm lighting plants can be sold to a limited extent in Southern Arabia. Aden, with a population of 50,000, including many Europeans and wealthy Parsee, Indian and Arabian merchants, has no central-station service. The heat makes electric fans most desirable, and the possibility of using individual lighting plants to operate them is a good selling factor.

United States exporters are very watchful of opportunities for the sale of petrol lighting and power sets in Argentina. The American Consul in Rosario recently reported a relatively good market for such units in Northern Argentina, where possibilities exist for their use in churches, small kinemas, country clubs, hospitals, dairies, engineering construction work, and on large estates remote from central power plants.

British manufacturers have already obtained a fair footing with a set, using either petrol or paraffin, furnishing from 40 to 75 lights of 16 candle-power each, or supplying four kilowatts for motion picture shows. Between £160 and £200 will purchase a lighting set for 125 lamps.

Small lighting outfits of this description are used for municipal lighting in towns which are too small to support a general power plant as well as in mountain hotels and country holiday resorts.

Excellent openings also arise from the circumstance that in many districts of Northern Argentina farming operations on a large scale are conducted from a central group of buildings or several groups, in which extensive industrial operations, too, are carried on, such as dairying, milling, and tanning.

Most of the farms are already supplied with small gas engines and windmills. The possibility of utilising these types of drive should also be kept in mind. The electric motor could be adapted to corn-shelling, cream separating, ice-making, sheep-shearing, milking, and pumping.

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sexton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

12,642. "Methods of making tungsten wires." British Thomson-Houston Co., Ltd. (General Electric Co.). May 4th.
12,654. "Electro-mechanical apparatus for working siding points." A. Monard. May 4th. (France, May 30th, 1921.)
12,662. "Antenna systems for wireless communications." E. Y. Robinson. May 5th.
12,674. "Recording sound vibrations and reproducing same in synchronism, with projection of kinematograph pictures." G. H. Woodhall and M. E. Woodhall. May 5th.
12,714. "Automatically cleaning sparking plugs." M. Viterbo. May 5th.
12,719. "Selecting devices for telephone systems." E. A. Petithory and Siemens Bros. & Co., Ltd. May 5th.
12,724. "Sparking plugs." H. E. Parkes. May 5th.
12,735. "Electric irons." Callender's Cable and Construction Co., Ltd., and E. Warbrick. May 5th.
12,753. "Bi-polar electrode electrolyzers." S. F. Barclay, Mather and Platt, Ltd., and H. E. Mellor. May 5th.
12,759. "Sound-recording and reproducing instruments." W. E. Clifton, Cliftophone, Ltd., and J. E. Collyer. May 5th.
12,763. "Telephone mouthpiece." C. E. Brown and F. W. Cox. May 5th.
12,768. "Head lights for vehicles." F. L. Rapson. May 5th.
12,769 "Electric switches and/or electric incandescent lamps." G. Morel. May 5th.
12,770. "Direct-current generators and motors." C. L. Thompson. May 5th.
12,771. "Train control." Automatic Telephone Manufacturing Co., Ltd. May 5th.
12,775. "Means for supporting incandescent electric lamps." S. Jonas. May 5th.
12,785. "Relays for protection of electric circuits, apparatus, &c." A. E. Drew. May 6th.
12,788. "Shades for electric lamps, &c." A. N. Haworth. May 6th.
12,793. "Electrical energy supply systems." J. W. Cox. May 6th.
12,795. "Electric lighting of motor vehicles." L. Newsome. May 6th.
21,834. "Illuminated electric sign." A. E. Foxlee. S. G. Higgins, C. T. Marks. May 6th.
12,837. "Sparking plugs." F. R. Lang and F. Wright. May 6th.
12,844. "Electric relays." Métallurgique Electrique. May 6th. (France, May 21st, 1921.)
12,845. "Electric relays." Métallurgique Electrique. May 6th. (France, May 25th, 1921.)
12,855. "Conversion of electric currents." M. D. Hart. May 6th.
12,856. "Induction coils." H. B. Gough and Watson & Sons (Electro-Medical), Ltd. May 6th.
12,861. "Ignition magnetos for internal-combustion engines." J. H. Chambers and H. Lucas. May 6th.
12,862. "Multiple-control apparatus for electric railways." Akt. Ges. Brown, Boveri et Cie. May 6th. (Switzerland, December 20th, 1921.)
12,868. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. May 6th. (United States, May 18th, 1921.)
12,869. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. May 6th. (United States, May 14th, 1921.)
12,880. "Motor-vehicle lamps for signalling." E. W. Parrish. May 6th.
12,885. "Electrically-controlled gear box." A. E. W. Maseyk. May 8th.
12,886. "Electric welding of cast iron." K. A. Homer. May 8th.
12,890. "Electric generators, motors, &c." R. W. Sutherland and F. Wilde. May 8th.
12,910. "Electric motors." H. F. Basset and J. H. Wild. May 8th.
12,914. "Electric lamp reflectors." M. Guthrie. May 8th.
12,927. "Plug and socket connections for electric circuits." M. W. W. Mackie. May 8th.
12,933. "Effecting variable ignition for internal-combustion engines." C. J. Hirons. May 8th.
12,939. "Dynamos and motors." M. W. W. Mackie. May 8th.
12,945. "Electric telegraphic apparatus." J. C. Needham. May 8th.
12,949. "Sound-reproducing machines." British Thomson-Houston Co., Ltd. (General Electric Co.). May 8th.
12,959. "Setting arrangements for selectors in automatic, &c., telephone systems." C. A. W. Hultman. May 8th. (Sweden, May 28th, 1921.)
12,970. "Method for pupinising high-frequency telephone lines." Felten and Guilleaume Carlswerk Akt. Ges. May 8th. (Germany, May 7th, 1921.)
12,971. "Multiple-control apparatus for electric railways." Akt. Ges. Brown, Boveri et Cie. May 8th. (Switzerland, April 1st.)
12,974. "Locking device for electric lamps." J. Houston. May 8th.
12,975. "Method for manufacture of glow lamps." Deutsche Glimmlampen Ges. and J. M. Schmierer. May 8th. (Germany, May 9th, 1921.)
12,977. "Electric contact plug." M. A. Persson. May 8th.
12,985. "Oxide cathodes for discharge tubes." A. Wehnelt. May 8th. (Germany, May 6th, 1921.)
13,007. "Electric condensers, &c." T. F. Wall. May 9th.
13,047. "Wireless systems." N. F. S. Hecht. May 9th.
13,048. "Thermionic valve circuits." N. F. S. Hecht. May 9th.
13,055. "Sound amplifiers for phonographs, &c." C. Stille and Telegraphie Ges. System Stille. May 9th.
13,059. "Electric switches." G. H. Armstrong. May 9th.
13,067. "Electric fittings." D. W. Dant and W. E. Evans. May 9th.
13,079. "Controllers for electrical apparatus." R. Brooks, B. A. G. Churcher and Metropolitan-Vickers Electrical Co., Ltd. May 9th.
13,080. "Controllers for electric traction, &c." R. Brooks, R. G. Cunliffe and Metropolitan-Vickers Electrical Co., Ltd. May 9th.
13,081. "Controllers for electrical apparatus." Metropolitan-Vickers Electrical Co., Ltd., and A. Priestley. May 9th.
13,082. "Controllers for electric traction, &c." R. Brooks, W. T. Gray, and Metropolitan-Vickers Electrical Co., Ltd. May 9th.
13,084. "Leading-in conductors for vitreous material." G. Holst, D. Lely, and Naamlooze Vennootschap Philips' Gloeilampen Fabrieken. May 9th.
13,085. "Leading-in conductors for vitreous material." G. Holst, Naamlooze Vennootschap Philips' Gloeilampen Fabriken, E. Oosterhuis and J. C. Lokker. May 9th.
13,089. "Regulation of heating systems in power stations, &c." English Electric Co., Ltd. May 9th.
13,095. "Electrically-operated organs." J. H. Compton. May 9th.
13,117. "Magnetic separators." R. Greaves. May 10th.
13,127. "Electric switchboxes, inspection boxes, &c." A. D. Clarke and P. O. Knowles. May 10th.
13,151. "Carrying case for electric lamps." J. C. N. Eastick. May 10th.
13,168. "Electric lamps for mines, &c." M.L. Magneto Syndicate, Ltd., and H. S. Potter. May 10th.
13,169. "Electric cables." S. E. R. Beecroft, Callender's Cable and Construction Co., Ltd., and A. H. Horsfield. May 10th.
13,187. "Wireless telegraphy and telephony." H. Booth. May 10th.
13,211. "Fuse boxes." C. A. Damey. May 10th.
13,215. "Electric relays." British Thomson-Houston Co., Ltd. May 10th. (United States, July 5th, 1921.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1920.

29,479. "Electric switches for telephone systems." E. W. Pattison (Dictograph Products Corporation). October 19th, 1920. (178,868.)
30,576. "Modulation of electrical oscillations and the like." J. Scott Taggart and Radio Communication Co., Ltd. October 29th, 1920. (178,872.)
30,628. "Multiplex telegraphy and like electric signalling." E. Potter (F. E. Pernot and L. J. Rich). October 29th, 1920. (178,873.)
32,159. "High-tension electric ignition devices." R. Bosch Akt. Ges. April 24th, 1920. (162,636.)
33,546. "Electric accumulators or storage batteries." H. Leitner. November 27th, 1920. (178,879.)
35,912. "Ignition magnetos." E. Marelli. December 24th, 1919. (155,779.)

1921.

2,483. "Ignition systems for internal-combustion engines." R. Bosch Akt. Ges. January 19th, 1920. (158,270.)
2,484. "Ignition systems for internal-combustion engines." R. Bosch Akt. Ges. January 19th, 1920. (158,271.)
2,509. "Fuse boxes for electric cables." R. A. Macaulay. January 19th, 1921. (Cognate application 18,075/21.) (178,905.)
2,560. "Electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). January 19th, 1921. (178,906.)
3,579. "Electrical welding of chain links or the like." Columbus McKinnon Chain Co. July 7th, 1920. (166,104.)
2,756. "Sound reproducing machines." J. G. A. Kitchen. January 21st, 1921. (178,911.)
2,785. "Arrangement for reinforcing weak continuous currents." D. Reichinstein. February 25th, 1920. (159,499.)
2,903. "Apparatus for suppressing earthing currents in high voltage nets." Siemens Schuckertwerke Ges. January 31st, 1920. (Addition to 157,123.) (158,550.)
2,841. "Means for transforming light impulses into electric current impulses." T. H. Nakken. January 21st, 1921. (178,917.)
2,911. "Electrodes and methods of making the same." British Thomson-Houston Co., Ltd. (General Electric Co.). January 22nd, 1921. (178,926.)
3,009. "Electron discharge tubes." Soc. Anon. pour l'Exploitation des Procédés M. Leblanc Vickers. April 2nd, 1920. (161,157.)
3,012. "Signalling apparatus for use in mines and other places." T. Chismon. January 24th, 1921. (178,930.)
3,105. "Number dials for automatic and semi-automatic telephone systems and the like." Siemens Bros. & Co., Ltd., E. A. Petithory and J. E. Collyer. January 25th, 1921. (178,936.)
3,368. "Sound amplifiers." W. F. Smith. January 26th, 1921. (178,944.)
3,381. "Sparking plugs." L. Wells. January 27th, 1921. (178,950.)
3,454. "Electric burglar alarms." "Alarm" Ges. fur Einbruchsichere Anlagen and A. Bachmeyer. January 28th, 1921. (178,954.)
3,527. "Delay action devices employing thermionic valves." N. Lea and Radio Communication Co., Ltd. January 29th, 1921. (178,957.)
3,576. "Means for automatically varying an electrical resistance for use in connection with the printing of kinematograph negatives." L. Lobel. February 3rd, 1920. (158,829.)
3,610. "Automatically variable electrical resistances for printing kinematograph negatives." L. Lobel. September 27th, 1920. (Patent of addition not granted.) (169,677.)
4,057. "Electric switches." C. L. Arnold and C. R. Belling. February 3rd, 1921. (178,967.)
4,228. "High-frequency electrical apparatus." Mitchell's Electrical and Wireless, Ltd., and R. Heather. February 4th, 1921. (178,971.)
4,247. "Electric furnaces." Automatic Telephone Manufacturing Co., Ltd., and P. N. Roseby. February 5th, 1921. (178,973.)
4,267. "Means for regulating the current output of dynamo-electric generators." J. W. Torrance and J. M. Torrance. February 5th, 1921. (178,974.)
4,320. "Dimming device for use in connection with electric lamps for motor vehicles and for other purposes." Brolt, Ltd., and W. Holt. February 7th, 1921. (178,976.)
4,538. "Switches for electric circuits." A. Gerhold. February 8th, 1921. (178,980.)
5,086. "Levers or point boxes for operating switches on railways or tramways." O. R. Williams. February 14th, 1921. (178,990.)
5,232. "Radio transmitting systems." British Thomson-Houston Co., Ltd., and E. F. W. Alexanderson. February 15th, 1921. (178,992.)
5,916. "Conduit tubing, connexions, bends, and all such appliances as used for and in the process of electric light wiring and other purposes." T. Hayward. February 22nd, 1921. (179,003.)
5,950. "Electric signalling systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). February 22nd, 1921. (179,006.)
6,009. "Coupling rod drive of driving axles of electrically-driven vehicles." E. C. R. Marks (Akt. Ges. Brown, Boveri et Cie.). February 22nd, 1921. (179,008.)
6,110. "Electric switch." T. W. Rogers (F. Krupp Akt. Ges.). February 23rd, 1921. (179,009.)
6,370. "Inverted voice current transmissions." Western Electric Co., Ltd. (Western Electric Co. Inc.). February 25th, 1921. (179,016.)
6,388. "Rotors for electric generators." G. A. Juhlin, J. A. Kuyser, and Metropolitan-Vickers Electrical Co., Ltd. February 25th, 1921. (179,017.)
6,891. "Lanterns or like fittings for electric lamps." D. J. Duncan. March 2nd, 1921. (179,020.)
6,917. "Electric switches." W. A. Coates and Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric and Manufacturing Co.). March 2nd, 1921. (Patent of addition not granted.) (179,021.)
7,201. "Protective arrangement for high-voltage insulators for electric precipitating installations." Siemens Schuckertwerke Ges. March 9th, 1920. (Addition to 159,130.) (159,881.)
8,349. "Gearing for starting motors and electrical generators as used on internal-combustion engines." Armstrong Siddeley Motors, Ltd., and F. R. Smith. March 17th, 1921. (179,032.)
8,962. "Circuit making and breaking device." E. Schattner. March 23rd, 1921. (Addition to 169,510.) (179,042.)
9,098. "Process of and apparatus for production of high vacua." N. Tesla. March 24th, 1921. (179,043.)
9,657. "Circuit making and breaking device." E. Schattner. March 31st, 1921. (Addition to 169,510.) (Cognate application 28,047/21.) (179,047.)
10,800. "Electric plug and socket connectors." A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. April 13th, 1921. (179,063.)
12,397. "Magneto-electric generators for use in connection with internal-combustion engines." C. A. Godfree. April 29th, 1921. (179,073.)
13,415. "Wire drawing dies." Western Electric Co., Ltd. May 13th, 1920. (163,269.)
13,557. "Instructional device for facilitating explanation of the construction and winding of electric armatures and demonstration of the effects of wrong connections and errors in manufacture." C. B. Brook. May 13th, 1921. (179,081.)
14,702. "Electrical furnaces." I. Rennerfelt. June 2nd, 1920. (164,019.)
17,603. "Electric motor control systems." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). June 28th, 1921. (179,093.)
34,865. "Arrangement for obtaining electric energy at a low voltage from high voltage networks." Siemens Schuckertwerke Ges. December 30th, 1920. (173,517.)

1922.

8,210. "Electric circuit interrupters." Metropolitan-Vickers Electrical Co., Ltd. March 23rd, 1921. (177,519.)